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THE CLIMATIC LIMITS OF WHEAT CULTIVATION, WITH SPECIAL REFERENCE TO NORTH AMERICA.*

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The Control by Rainfall Conditions.

While in the more northerly portions of North America heat is the more important climatic factor in limiting cultivation, the rainfall is the determining condition in the central and southern portions. In Canada, southern Alberta and south-western Saskatchewan may be considered semi-arid. In the United States the intermontane basins and valleys of the west are arid or semi-arid, and the region of the Great Plains from about the 100th meridian to the foothills of the Rocky Mountains have at present very little economic value on account of the scanty rainfall. Irrigation with water precipitated upon the mountain ridges can be employed only over a small proportion of these immense regions. Over vast areas a meagre rainfall is the only source of water, and cultivation is limited mainly by the amount of this rainfall and its distribution throughout the year.

Consequently the cultivation of various crops in the semi-arid regions has been the object of many investigations and experiments by the Department of Agriculture of the United States, and the results have been published in a long series of papers; † the experimental farms and stations of the various western states have also been largely concerned with the same work, and in the prairie provinces of the Dominion of Canada similar problems are present, although their solution is not felt to be so urgent as further south.

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* Continued from p. 366. Map, p. 420.

† These are indicated in the footnote references by the initials "D. A." after the title of the paper.

The problem of ascertaining the minimum rainfall conditions for wheat cultivation may be approached by calculating the amount of water needed by wheat in a semi-arid region, without any discussion as to the source of the water-supply. It was found at Rothamsted that wheat required during its life from 200 to 250 lbs. of water to produce 1 lb. of dry matter in the mature plant.* In Germany Hellriegel estimated the amount at over 300 lbs., and in Wisconsin experiments showed that the plants needed from 325 to 550 lbs. of water to produce 1 lb. of dry matter, while other investigations resulted in the conclusion that "an average of 750 lbs. of water is required to produce the same results in the arid climate of Utah."† Theory and experiment alike indicate that the amount of water required varies according to the heat and dryness of the air while the plant is growing, and the estimate of 750 lbs. may be accepted as quite adequate to the water requirements of wheat in a region on the margin of cultivation.

Hence it is necessary to ascertain the weight of dry matter produced per unit area in the same regions. Land being cheap and the labour given to the crops being scanty, a yield of 10 bushels of grain to the acre is found to be an average and paying crop in Western Kansas and Western Nebraska, where farmers are now pushing wheat cultivation into the semi-arid parts of the great plains.‡ This yield represents 600 lbs. of grain to the acre, and since a normal crop § has straw and chaff as compared with grain in the ratio of 1·5 : 1, the total weight of the crop would be 1500 lbs. per acre. As this grain and straw is only "air-dry," it would contain about 15 per cent. of water; ‖ and the actual weight of the dry matter would be 1275 lbs. per acre. The water requirement of the wheat may therefore be obtained by multiplying this weight by 750, which gives a result of 427 tons per acre, and as an acre of water 1 inch deep weighs about 112 tons, the wheat would need water from the soil equivalent to that supplied by 3·8 inches of rainfall.

This takes no account of the fact that on an average only about 90 per cent. of the water actually in the soil can be taken up by the plant, so that, although the plant needs rather less than 4 inches, the soil must contain perhaps 10 per cent. more than this,§ *i.e.* rather more than 4 inches.

Further, unless the grain were cut immediately upon ripening, additional moisture would be required for loss by transpiration even after the grain

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* J. B. Lawes, "Investigations into the Amount of Water given off by Plants," *Journal of the Horticultural Society of London*, vol. 5.

† Elwood Mead, 'The Relation of Irrigation to Dry Farming.' D. A., 1905.

‡ E. C. Montgomery, 'Crop-Production under Humid and Dry Conditions.' D.A., 1907.

§ F. H. King, 'Irrigation and Drainage.' New York, 1907.

‖ B. T. Galloway and A. F. Woods, 'Water as a Factor in the Growth of Plants.' D.A., 1894.

itself had reached maturity. It would therefore appear that in an arid region the minimum requirement of the plant itself may be estimated as the water equivalent to about 4 or 5 inches of rain; consequently, as loss would occur by evaporation, surface run-off, and downward percolation, for this amount to be available for the plant the actual rainfall must exceed this, possibly by many inches.

The statement that the minimum requirement of the plant is the water equivalent to 4 to 5 inches of rain is supported by a critical instance recorded by the wheat experimentalist at the Coolabah Experimental Farm in the semi-arid region of New South Wales, Australia.* In 1904, grain matured in a plump condition, although with a somewhat scanty yield, in a season during which the rainfall was such that apparently minimum conditions obtained. "The seed was planted on May 26, and the harvesting done on November 10. As the rain which fell during the month previous to the planting of the seed would be of benefit to the crop, the rainfall of the month previous to the date of sowing is included in the return." The following return gives the daily rainfall during the period, and shows that the total amounted to 5·32 inches.

April	30	...	...	...	0·25 inch	July	21	...	...	0·08 inch
May	1	...	...	...	0·38 ,,	,,	26	...	...	0·08 ,,
,,	10	...	...	...	0·19 ,,	August	7	...	...	0·08 ,,
,,	17	...	...	...	0·12 ,,	,,	28	...	...	0·38 ,,
,,	23	...	..	...	0·14 ,,	,,	31	...	...	0·02 ,,
,,	27	...	...	...	0·04 ,,	September	11	...	...	0·12 ,,
,,	29	...	...	...	0·11 ,,	,,	24	...	...	0·05 ,,
June	21	...	...	...	0·05 ,,	,,	27	...	...	0·02 ,,
,,	22	...	...	...	0·06 ,,	,,	28	...	...	0·07 ,,
,,	30	...	...	...	0·02 ,,	October	5	...	...	0·18 ,,
July	1	...	...	...	0·08 ,,	,,	11	...	...	0·01 ,,
,,	7	...	...	...	0·03 ,,	,,	12	...	...	0·26 ,,
,,	8	...	...	...	0·79 ,,	,,	13	...	...	0·46 ,,
,,	9	...	...	...	0·08 ,,	,,	20	...	...	1·09 ,,
,,	10	...	...	...	0·01 ,,	November	1	...	...	0·02 ,,
,,	15	...	...	...	0·05 ,,					
								Total	...	5·32 inches

"As light falls of under 0·10 inch only wet the surface and do practically no good unless they fall on consecutive or nearly consecutive days, and then aggregate over 0·10 inch, 0·85 inch could be deducted . . . without much harm being done to the crop. . . . The principal falls came at times when they were wanted. . . . The variety of wheat was "Nutcut" —a new cross-bred bread-wheat (*Triticum sativum*)." In this case, therefore, the grain obtained no more than 4·5 inches of rainfall.

Next the variety of the wheat must be taken into account, although the

* Letter from Mr. W. Farrar, Wheat Experimentalist, Department of Agriculture, New South Wales.

data at present available do not admit of a quantitative allowance being made. Hard spring-wheats from the semi-arid region of the lower Volga have been introduced into America,* and are found to be both hardy and drought resistant; they are, therefore, well adapted to the northern portion of the great plains of the United States and the "North-West" of Canada. From the Crimea and the Taurida and Kharkof governments of Russia winter varieties have also been obtained, and these, although less suited to the cold of the higher latitudes, have an advantage over the spring varieties in being able to utilize the rainfall of a longer period. They are, therefore, extensively employed in the central and southern portions of the great plains in the United States and in the southern part of Alberta.

The greatest advance was made by the introduction of the sub-species known as durum or macaroni wheat (*T. durum*) from Russia and Algeria. This wheat requires relatively little moisture, and has other valuable characteristics, namely, its immunity against rust and its high nitrogen-content; on the other hand, the grain is so hard that with the ordinary machinery milling presents great difficulties, and the millers therefore opposed the introduction of the durum wheat, at first purchasing it only at a low price. Nevertheless, it is now grown in great quantities, and in the driest regions it is the wheat which must be mainly taken into account. An illustration of its drought-resistant qualities is afforded by experiments in western Dakota. The year 1904 was exceptionally dry, and under these conditions the yield of the specially-bred, hard spring variety, "Pedigreed Bluestem," fell to 11·8 bushels per acre, but the "Kubanka" variety of durum wheat gave 23·5 bushels per acre.†

If allowance is made for the smaller quantities of water required by such drought-resistant varieties, the estimate made above of 4 or 5 inches of rain being needed by wheat must be considered as ample. It by no means follows, however, that the condition under which wheat may be produced is that the rainfall for the period of growth should amount to 4 or 5 inches. On the one hand, the rainfall of the growing period may be evaporated, may percolate downward beyond the reach of the roots, or, though held in the soil itself, may not be utilized by the plant. On the other hand, water may be stored in the soil from earlier rains; for example, Canadian experience leads to the statement that "the plant utilizes from the ground very often more moisture than it receives from the rainfall," ‡ and in the United States "there have been numerous instances where wheat has been planted and never received a drop of rain." §

* M. A. Carleton, "Successful Wheat Growing in Semi-Arid Districts." D.A., 1900. Elwood Mead, *op. cit.*

† C. Salmon, "Dry-Land Grains for Western North and South Dakota." D.A., 1910.

‡ Letter from Dr. Saunders, Director of the Canadian Experiment Farm.

§ Letter from C. P. Bull, Experiment Station, St. Paul, Minnesota.

As mentioned above, in semi-arid regions where the winter is not too severe, autumn-sown wheat is preferable to spring-sown wheat because it has a longer period in which to take up water and nutriment from the soil, and where the wheat is planted in spring the great problem in "dry land farming," or "dry farming," as it is commonly called, is to conserve the moisture of a period preceding the sowing. The most effective method is to prepare the land as early as possible by forming and constantly maintaining a surface "mulch," that is, a layer of loose dry soil a few inches deep. The large air spaces between the soil grains of the mulch allow the rain to sink rapidly downward under the influence of gravity, but retard its return to the surface by hindering the upward movement due to capillarity which tends to take place immediately the surface becomes drier than the layer beneath. Consequently a well-formed and well-preserved mulch may very considerably reduce the loss by evaporation. Moreover, the subsoil is "packed," that is, compressed so that the air spaces are both small and numerous, and the capacity of the subsoil for holding water is increased. Not only does the constantly dry surface prevent evaporation, but it forces the roots to develop downwards into the lower layer, and thus to become independent of changes in the moisture-content of the upper layers. This is the chief explanation of the fact that in humid regions the relatively shallow-rooted wheat dependent on the rainfall of the growing period may be injured by drought of one or two weeks which dries the surface, whereas in semi-arid regions the more deeply rooted wheat, utilizing the conserved soil-moisture, remains unaffected by long-continued drought.

Conservation of soil-moisture by such means is so effective that the practice of "summer-fallowing" has developed; after the wheat is cut the ground is allowed to lie fallow during the whole of the next year, its surface being maintained in a loose condition, so that in the following spring a considerable part of the rainfall of nearly two years is already stored in the ground when the wheat is planted.

Thus, in respect of the regions where dry farming is thoroughly practised, it may be necessary to ascertain the rainfall for two years in considering the yield of a *particular* crop, and in discussing *average* conditions it is the mean annual rainfall which must be ascertained.

Such is the effectiveness of the various methods of dry farming, including the selection of drought-resistant varieties, that wheat can now be grown in semi-arid regions in which cultivation would be entirely impossible with the methods and varieties suitable to better favoured areas. Yet even with the most efficient "mulching," a certain amount of evaporation takes place; and the downward percolation and consequent loss of water must also be allowed for, except in the comparatively rare cases where this is prevented by the texture of the sub-soil. Hence the minimum rainfall must be more than the 4 or 5 inches needed by the plant itself.

In discussing this minimum, it is useful to examine the conditions in

districts where wheat is actually obtained with but a small annual rainfall, and it is necessary not only to ascertain the total amount of this, but also its distribution throughout the year. The conditions in California may first be examined, for here wheat is grown with a less rainfall than elsewhere in the United States. Wheat has for many years been grown without irrigation throughout northern and central California, and this has been done extensively so far south as Merced,* in 37° 20′ N. lat. Here the mean rainfall is 10·3 inches. This small amount is to be contrasted with the much greater amounts which for long seemed necessary in the Great Plains region, where in the same latitude the margin of cultivation, as shown by the maps based on the census of 1899, was found near Dodge, in Kansas, where the rainfall was 19·8 inches. The soils of California are naturally adapted to the conservation of moisture, being of the loose texture described above; on the contrary, over much of the Great Plains area special processes are necessary to produce a similar texture, and this has only recently been undertaken. Moreover, the wheat is subject to higher temperatures in Kansas, where the period of growth is from March to the end of June, than in California, where the plant is grown from September (or a later month) to May; the higher temperature induces more rapid transpiration and consequently a greater need of water.

Another difference between the regions is the distribution of the rain throughout the year. In central California the rain falls almost entirely in the winter and spring months, when the temperatures are comparatively low and the relative humidity of the air is comparatively high; while over the Great Plains the rains occur in the hottest and driest months of the year, as is shown in the following table:—

Mean Monthly Rainfall (in Inches) at Merced (California) and Dodge (Kansas).

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Merced ...	2·1	1·3	1·4	1·1	0·6	0·2	0·0	0·0	0·2	0·5	1·2	1·7	10·3
Dodge ...	0·4	0·6	0·9	1·8	3·1	3·3	3·2	2·8	1·3	1·3	0·5	0·6	19·8

Thus in California a relatively large proportion of the rainfall escapes immediate evaporation and sinks into the subsoil to be utilized by the deep-rooted wheat, while in the Great Plains more rain is immediately evaporated, and the remainder tends to be retained near the surface; here it is liable to loss by capillary movement, and also holds the roots near the surface, so that they are affected by any temporary failure of fresh supplies of rain.

* F. H. King, 'Irrigation and Drainage,' p. 6.

This comparison indicates that it may be well to give separate consideration to the two types of wheat-growing country: (1) That with a relatively mild winter with rain in the cooler parts of the year, where the grain is sown either in the autumn or spring and ripens before the hottest part of the summer, and (2) that with a more extreme climate with rain during the hotter part of the year, where the grain may perhaps be sown in the autumn, but more commonly is sown in spring, and in either case grows during the spring and also during summer, ripening at almost the hottest part of the year. The former climate is often described as the "Mediterranean" type; the latter may be called the "Continental" type. Regions such as Britain which fall into neither class are of less importance as wheat producers.

The case of California suggests that in lands of the Mediterranean type a mean annual rainfall of about 10 inches is sufficient if the soil conditions are suitable either naturally or by special cultivation. It is possible that the introduction of durum wheat from regions of similar climatic conditions in South Europe and North Africa would allow wheat to be grown with even less rainfall, but the fact that irrigation is easy in Southern California, where a low rainfall can be supplemented by water from the neighbouring mountains, has not encouraged the attempt to produce the less esteemed durum wheat. In restricted areas south of Merced in California, wheat is grown with a smaller rainfall, but it would be dangerous to apply conclusions drawn from these cases to regions of wide extent and varying local conditions.

A distinction must be drawn between the mean annual rainfall and the actual rainfall of years below the average. Below is given the rainfall at Merced for eighteen successive years, taking the twelve-monthly periods from June to June; from this it appears that in six years less than 10 inches of rain was obtained, and since in this region crops are raised every year, an actual rainfall of less than 10 inches must be adequate for the production of wheat, although in the drier years the yield is less abundant.

ANNUAL RAINFALL AT MERCED, CALIFORNIA, FOR THE PERIODS OF TWELVE MONTHS ENDING JUNE 30, IN THE YEARS FROM 1892 TILL 1909.

Year	1892	1893	1894	1895	1896	1897	1898	1899	1900
Inches	9·7	11·0	10·8	12·6	11·8	12·0	6·3	7·0	12·0

Year	1901	1902	1903	1904	1905	1906	1907	1908	1909
Inches	11·5	9·9	11·8	8·3	13·3	17·7	16·4	8·3	14·4

Even more scanty is the rainfall with which wheat is grown in Russian Turkestan. Here, especially in the Syr Daria, Ferghana, Samarkand, and

Trans-Caspian provinces, the irrigated lands are supplemented by "bogarny" fields situated just beyond the irrigated lands and oases, and watered only by precipitation.* This land receives a considerable part of its water in the spring, either as rain or from the melting of winter snows, and the mean annual rainfall for ten years at thirty-two of these settlements amounted to 8·3 inches, the distribution of this throughout the year being as follows:—

Mean Monthly Rainfall (in inches) at Thirty-two Stations in Russian Turkestan.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
0·9	0·7	1·4	1·2	0·9	0·5	0·3	0·2	0·1	0·7	0·7	0·7	8·0

This cultivation is truly marginal, for the yield cannot be relied on; that from the irrigated land is of the first importance, and in years of low rainfall the crops of the bogarny fields may be poor or fail entirely. Consequently, a mean rainfall of 8 inches must be regarded as a minimum under the conditions found in this region.

From the calculations made above as to the amount of water utilized by wheat in arid regions, it would appear that under the Turkestan conditions the wheat would in all probability require water equivalent to 4 inches of rain, so that only about half the annual rainfall is actually obtained by the plants.

In comparing this region with California account must be taken not only of the rainfall, but also of the temperature and relative humidity of the air, for, other things being equal, evaporation and transpiration vary directly as the temperature and inversely as the relative humidity of the atmosphere. The following tables show these conditions in Turkestan and in Central California respectively; Samarkand may be considered typical of Turkestan and Merced of Central California, but as there are no records of the relative humidity at Merced, those relating to Fresno, which is south-east of Merced, have been used.

Mean Monthly Temperatures (Deg. C.) at Merced and Samarkand.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Merced ...	8	11	13	16	19	24	28	26	23	18	13	9	17
Samarkand	0	2	8	14	19	24	25	23	19	12	7	3	13

* Prince Massalski, in 'Industries of Russia,' vol. 3. St. Petersburg, 1893.

MEAN MONTHLY RELATIVE HUMIDITY (PER CENT.) AT FRESNO AND SAMARKAND.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Fresno ...	70	70	66	56	49	38	30	33	39	52	57	77	54
Samarkand	77	75	71	66	55	50	50	45	50	60	65	75	62

Since in California, as compared with Turkestan, the temperature is higher and the relative humidity is lower almost throughout the year, there is every probability that evaporation and transpiration take place more rapidly, and that in consequence a greater rainfall is required. This tends to show that a mean rainfall of more than 8 inches is necessary, and that the mean amount of 10 inches received in the district around Merced could not be greatly reduced.

Another "Mediterranean" region from which statistical data can be obtained is the semi-arid north-western portion of Victoria, Australia The rainfall and yields of three consecutive years at Wycheproof are given below,* and a comparison with the figures for a series of years in this colony shows that the yield in December, 1901, must be considered as normal, that of 1902 as a total failure, and that of 1903 as extraordinarily high.

ANNUAL RAINFALL AND YIELDS OF WHEAT AT WYCHEPROOF, VICTORIA.

	1901.	1902.	1903.
Yield of wheat	7·75 bushels	1·50 bushels	27·75 bushels
Rainfall	10·0 inches	6·6 inches	19·0 inches

It seems more than probable that further experience in agricultural methods and the adoption of more drought-resistant varieties will yield paying crops with an annual rainfall of less than 10 inches. The distribution throughout the year of the rainfall at this station in 1901 is here given, showing that of the total amount 75 per cent. occurred during the colder six months, May to October.

MONTHLY RAINFALL AT WYCHEPROOF, 1901.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
0·5	0·4	0·3	1·1	0·2	2·0	1·3	1·3	1·8	0·9	0·2	0·0	10·0

In the same district, the crop of the year 1902 had a rainfall of 6·6 inches, but on one farm † this was supplemented by irrigation equivalent to an additional 3 inches, and a very good yield was obtained.

* *Bulletin* 13 of the Department of Agriculture, Victoria, 1904.

† *Bulletin* 25 of the Department of Agriculture, Victoria, 1905.

These statistics confirm the conclusion indicated by the preceding facts, and it is therefore submitted that *in regions of the Mediterranean type a mean annual rainfall of* 10 *inches is adequate for wheat cultivation; and where specially favourable circumstances obtain, such as lower temperatures or a very suitable soil, this amount may be reduced by one or even two inches.*

Regions of the continental type may now be considered. In Central California only about 15 per cent. of the total annual rainfall occurs during the warmer six months, May to October inclusive, but in the semi-arid portion of the Great Plains about 70 per cent. of the rainfall occurs in the same period; moreover, the harvest in California occurs in May, and that in the Great Plains in June or July. For the reasons given above, these facts suggest that a greater amount of rain is required in the Great Plains area than that stated in the preceding paragraph. The history of attempts at cultivation in this area is very instructive in the present inquiry. The westward movement of agriculture in the United States reached the semi-arid belt towards the end of the nineteenth century, and there took place what a report of the United States Geological Survey * termed the "Agricultural Experiment . . . a boom of immigration into the High Plains region, most marked in Western Texas." The same report summarizes it in these words—

"1. A one-year period (1888) of humid climate conditions which gave rise to the agricultural experiment.

"2. A one-year period (1889) of arid conditions, yet of heavy planting, and therefore total loss.

"3. A one-year period (1890) of light planting, but of fair precipitation and of moderate profits.

"4. A two-year period (1891–2) of heavy planting coinciding with heavy precipitation, and therefore a period of heavy profits.

"5. A four-year period (1893–6) of continuous heavy planting, but with the calamitous accompaniment of continuous drought.

"Finally, in 1898, a return to humid conditions, though after all effort had come to an end."

This "experiment" was conducted under conditions which foredoomed it to failure. Farmers pursued methods adapted to the more humid regions from which they had migrated, and only in the years when the climate of this region approximated to that of the eastern States was success possible. But since this failure the methods of dry-farming have been developed, and the results of the first attempt are almost entirely irrelevant to the problem of the future; hence the pessimistic forecasts based upon this experiment are untenable. How completely the situation has altered may be exemplified by contrasting the amount of rainfall available for successive crops under the new and old systems of cultivation respectively. The following table deals with the rainfall at Dodge,

* 'The High Plains and their Utilization.' 1899–1900.

Kansas, from 1888 to 1898 inclusive. The first column shows the total rainfall of each year; the second shows the amount that might be available when there was practically no attempt at conservation of soil moisture, so that only the rain of the month preceding the sowing, together with that of the growing season (March to June), could be considered; the third column shows the rainfall for the period during which water would be stored under the system of summer-fallowing, *i.e.* for the two years preceding each harvest month (June).

Precipitation (in Inches) at Dodge, Kansas, 1888–1898.

	Year.	Feb.–June inclusive.	Two years preceding the end of June.
1888	22·9	13·8	—
1889	19·2	8·8	—
1890	11·7	5·5	33·7
1891	32·3	16·0	37·3
1892	19·7	10·6	49·6
1893	10·1	2·4	37·6
1894	12·6	7·1	26·0
1895	20·3	10·8	33·5
1896	19·9	8·9	34·1
1897	21·6	9·6	40·1
1898	31·5	16·8	51·4
Mean	20·1	10·0	38·2

These statistics not only show that a greater amount of water is drawn upon by the method of summer-fallowing, but they also illustrate what is even more important, namely, that the deficiencies of particular seasons are much reduced by extending the period during which water is collected. The disasters of the first settlers were due, not to the low average, but to the great deviations from this average in certain seasons. The three years in which these deviations were greatest were 1890, 1893, and 1894, and in the following table the deviations are expressed as percentages of the mean, both in the case of the short and long periods of water-collection:—

Percentage Deviations from the Mean Rainfall of the Period 1888–1898.

	Feb.–June inclusive.	Two years preceding the end of June.
1890	45 %	12 %
1893	76 %	2 %
1894	39 %	32 %

In each case the deficiency was greater in the short period, and in the worst year (1893) under the old conditions, when only a quarter of the normal rainfall was obtained, the preceding months were so wet that the

rainfall of the longer period which summer-fallowing would have drawn upon was only 2 per cent. below the normal.

Even while most of the settlers in the drier part of the Great Plains region failed, Russian emigrants met with success by adopting the various methods they had learned in their own country, including surface mulching, the employment of Russian varieties, and rotations, such as that of melons, durum wheat, hard red wheat, and a pasture crop.* These methods are adaptable to this region, and the scientific experimental work of the State and Federal agriculturalists will doubtless improve upon them. It is useful, therefore, to consider under what conditions wheat cultivation is carried on in Russia, for in all probability cultivation under similar conditions will be found practicable in America.

In South-eastern Russia cultivation is carried on in the government of Astrakhan, whence varieties have been introduced into the United States; here the mean annual rainfall is a little less than 10 inches, but the south-eastern boundary of the area which yields very considerable crops and may therefore be termed a "wheat country" is approximately marked by that part of the lower Volga which flows south-westward and has on its banks, near its south-western angle, the town of Kamychin, where the mean annual rainfall is 10·9 inches, with a distribution as follows:—

Mean Monthly Rainfall (in Inches) at Kamychin, Russia.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
0·6	1·1	0·5	1·0	0·9	1·2	0·8	1·0	1·0	1·1	0·8	0·9	10·9

Since the greater part of the rainfall in South-eastern Russia occurs during the warmer six months, the conditions in this region may be compared with those in the Great Plains area of North America. Perhaps the closest comparison may be made between the lower Volga region and the west of Northern Dakota. In this latter district an experimental station has been established at Dickinson (long. 102° 50′ W.); here wheat has now been grown for a number of years, the soil is typical of extensive areas in North Dakota, and the mean annual rainfall is 14·5 inches, distributed as here shown.

Mean Monthly Rainfall (in Inches) at Dickinson, North Dakota.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
0·3	0·6	1·0	1·6	2·0	2·2	2·1	1·9	0·9	0·7	0·6	0·6	14·5

The question arises whether this rainfall is the minimum which can be utilized in this region, and so its distribution throughout the year and

* M. A. Carleton, 'Successful Wheat Growing in Semi-arid Districts.' D.A., 1900.

the temperature and relative humidity of the atmosphere may be compared with those of the lower Volga region. At Dickinson 68 per cent. of the rainfall occurs in the hotter six months, and so it would appear that a greater annual rainfall would be required than at Kamychin, where only 55 per cent. occurs during the same period. On the other hand, the following table shows lower mean monthly temperatures at Dickinson than at Kamychin :—

MEAN MONTHLY TEMPERATURES (DEG. C.) AT DICKINSON AND AT KAMYCHIN.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Dickinson	−12	−11	−5	6	12	17	21	19	13	7	−4	−8	4
Kamychin	−11	− 9	−3	7	16	21	23	22	15	7	1	−7	7

Hence, as far as temperatures are concerned, it would seem that a less annual rainfall would be sufficient in the American region, and these two factors of seasonal distribution of rainfall and temperatures would tend to balance one another.

The relative humidity of the atmosphere has not been recorded at Dickinson, but it may be estimated by taking the mean of the observations at Pierre in North Dakota and Miles City in Montana, which lie approximately in the same latitude, but east and west of Dickinson respectively.

MEAN MONTHLY RELATIVE HUMIDITY (PER CENT.) AT DICKINSON AND AT KAMYCHIN.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Dickinson ...	76	77	74	69	62	66	60	56	61	68	73	75	68
Kamychin ...	86	86	85	70	55	59	54	54	64	75	86	87	72

It appears that, taking the year as a whole, the relative humidity is rather lower at Dickinson, but during the months of May, June, and July, when the rainfall is greatest and the growth of the wheat most vigorous, there is a higher relative humidity at Dickinson. From this point of view the rainfall required is not likely to be greatly different in the two regions, and possibly might be rather less at Dickinson than at Kamychin. Consequently, if a mean annual rainfall of 11 inches is adequate in the Volga region, it would seem quite adequate in the northern part of the Great Plains, if the possibility of years of serious deviation from the normal is for the present excluded.

This suggestion is supported by the experience at Highmore in South Dakota.* Here the temperature is higher and the relative humidity is

* J. A. LeClerc, 'The Effect of Climatic Conditions upon the Composition of Durum Wheat.' D. A., 1906.

lower, but in the year 1904 a rainfall of 10·5 inches was sufficient to produce an abundant yield of the durum wheat.

Moreover, in 1903, at Holyoke, situated in north-eastern Colorado, and therefore in the central part of the Great Plains region, with still higher temperatures and lower relative humidity, wheat was grown upon a rainfall of 11 inches.* This is, of course, not the mean amount at this station, but the fact is adduced here as another indication that further north an actual rainfall of *less* than this amount would be sufficient.

Hence, taking into account both the conditions under which wheat is grown in South-eastern Russia and the recent experience at the stations in the semi-arid region of the United States, and also bearing in mind the probability of further advances in scientific methods and the breeding of drought-resistant varieties, it would appear that *a mean annual rainfall of* 11 *inches will be adequate over the northern part of the Great Plains of the United States. Consequently, it is probable that a greater mean amount would be required in the more southerly portions, but of this no numerical estimate can be made from the data obtainable. On the other hand, somewhat less than* 11 *inches would probably be adequate in the Canadian part of the area.*

The corollary is, that as there is no record of any stations in southern Canada receiving a mean annual precipitation of less than 11 inches, the whole of the Great Plains area within the Dominion is capable of wheat cultivation, for of the means compiled by the Canadian Meteorological Service in 1906, the lowest was 12·2 inches at Macleod, and the next lowest 13·9 inches at Medicine Hat.†

Canadian experience in the past is as little likely to be a guide to the future as that of the United States, and the fact that for years the western boundary of cultivation in Saskatchewan was near Moosejaw in 105° 40′ W. long. is no proof that the western part of that province and the eastern part of Alberta will be found too dry for cultivation. The methods employed in Canada were not the best adapted to the region, and long after the reports of the experimental stations had advocated conservation of soil moisture and summer fallowing, farmers retained their accustomed methods. Thus a report of an inquiry in this region by the chemist of the Nebraska Experimental Station reads: ‡ "Each grain crop on the experimental farm at Indian Head [Saskatchewan] is usually followed by a year of clean cultivation. . . . In general, however, the farmers in Saskatchewan employ the fallow only every fourth or fifth year, and then carry it out so poorly that at the end of July, 1904, very few properly worked fallows were to be seen in a journey of several hundreds of miles through grain-producing country."

There is, therefore, no reason for doubting that even the semi-arid

* C. Salmon, *op. cit.*

† Evidence of the Director of the Meteorological Service of Canada before the Select Committee of the Dominion. 1906–07.

‡ F. J. Alway, 'Some Soil Studies in Dry Land Regions.' D. A., 1908.

region west of Moosejaw will be found cultivable throughout its extent in normal years, but the case of exceptional dry years must be specially considered. The year 1900 was one of the driest on record, and at the Indian Head Experimental Farm the drought was particularly serious. The wheat crop sown on stubble (*i.e.* not on summer-fallowed land) received from the end of July, 1899, until the end of July, 1900, a total precipitation of rain and snow of only 8·5 inches, although the mean annual precipitation is over 16 inches; consequently the crop was almost ruined, and the very low yield of 5·4 bushels per acre was obtained. Yet in the same year, and on neighbouring ground, the crop on summer-fallowed land (then the subject of experiment) yielded 15·7 bushels per acre.* Since the meteorological conditions of this experiment were exceptionally unfavourable, for in addition to the lack of rain the year was "characterized by high temperatures and hot winds," and nevertheless the yield obtained by the newer methods was not very much below the normal amount, the failure of crops on summer-fallowed land may be regarded as an altogether exceptional occurrence, especially when the still more recently introduced drought-resistant varieties are considered.

That even yet the advantages of the newer methods are not commonly appreciated, and that in consequence the value of the less favourable conditions is not realized, is shown by the following extract from a report on "Grain-growing in Western Canada," † written at the end of 1911: "The difference between the results achieved by different men under identically the same natural conditions is very striking. In one very new district I found nearly all the farmers reporting . . . that they had got no wheat crop last year owing to the drought. In the very middle of them I found a farmer who had got 1300 bushels, the average yield running from 10 to 14 bushels an acre on different parts of his land. That land had not received a drop more moisture than the fields around it. The difference was in the way it had been worked. Its owner is a wide-awake man, a welcomer and a practiser of innovations."

The conclusion is, therefore, that *with the adoption of suitable methods of cultivation, including summer-fallowing and the use of drought-resistant varieties, wheat cultivation will be possible over the whole of the semi-arid region of southern Alberta and Saskatchewan.*

It does not follow, of course, that wheat farming will replace cattle grazing as the predominant industry in this region; that point will be ultimately determined by the relative profits in the two industries—profits which depend on a number of factors, economical and political as well as physical.

The difficulty arising from the occurrence of exceptionally dry years is much more important in the United States, and here this will no doubt be the chief factor in limiting the westward extension of wheat cultivation. The irregularity of precipitation over the Great Plains region is illustrated

* F. J. Alway, *op. cit.*

† *The Times*, December 18, 1911.

by the rainfall at Dodge, of which statistics were given above: in 1891 there was a rainfall of 32·3 inches, while two years later the amount fell to 10·1 inches. Further west the irregularity is quite as marked and the totals are less, and experience gained at several stations during the last few years has shown that a rainfall sufficient for wheat is not the only necessity for dry farming on the very margin of cultivation.*

Drought, which for cereals can be overcome by summer-fallowing, inevitably prevents the growth of trees and perennial plants such as the alfalfa needed as forage for stock. Trees are particularly valuable to farmers in dry country, not only for their welcome shade and the relief they afford to the monotony of the landscape, but as wind-breaks to lessen the force of the winds which may blow away the light dry surface of the mulch. This "blowing" of soils is as serious a problem as lack of water, at least over parts of the great plains,† and one of the chief means of preventing it is the planting of lines of timber running east and west to check the strong northerly and southerly winds. Some water is therefore required to give to the trees and forage crops in times of exceptional drought, and the farmer is also greatly aided if he can grow fruit and vegetables for his own use; this necessitates the irrigation of a small patch of ground. Water is, of course, also needed for domestic purposes and for the stock, and consequently the extension of dry farming depends upon the possibility of getting a certain amount of water beyond that afforded by the uncertain and irregular rainfall.

It may be possible in some cases to construct reservoirs to store some of the rain, but more use is likely to be made of water obtained either from streams or from underground supplies. Where the rainfall is very scanty and streams are distant, the possibility of obtaining water from the ground may depend entirely upon such developments as hydrographic surveys by the Government, and combined action by the farmers in sinking deep wells and maintaining wind-driven pumping machinery. In reference to this supply of supplementary water, Elwood Mead,‡ of the United States Department of Agriculture, wrote: "It is believed that it is possible to control enough water to irrigate from one to ten acres of land in each of the thousands of farms where complete irrigation is not possible;" and, again: "There are few localities in the arid region where enough water cannot be had for the irrigation of one to ten acres on each station. It is remarkable what good can be done with a little water when rightly used."

Another factor in the determination of the possibility of dry farming is the kind of soil. Statements apparently contradictory come from two investigators dealing with this matter. Elwood Mead writes: ‡ "Through summer fallowing, drought-resistant crops can be grown alternate years with

* Elwood Mead, 'The Relation of Irrigation to Dry Farming.' D.A., 1905.

† L. E. Hazen, "Blowing Soils." In 'Dry Land Agriculture.' D.A., 1907.

‡ Elwood Mead, *op. cit.*

a fair degree of success over those portions of the semi-arid regions where the soil is sandy or a sandy loam, but not in the clay or adobe soils." On the other hand, C. S. Schofield writes:* "The water-holding capacity of soil depends largely upon its physical texture, . . . a heavy clay containing a large amount of humus might hold 30 per cent. of water and still be in a workable condition, while sandy soil having 10 per cent. of water might seem very wet. . . . Estimating that a wheat crop can use moisture 5 feet deep in the soil, a sandy soil would be able to hold available only about 540 tons of water per acre, while a heavy loam would hold available about 1350 tons per acre." He then deduces "the importance of selecting only the heavier soils for dry farming where the storage of water from one season to another is necessary."

The reason for the discrepancy would appear to be that the first writer in his statement deals only with the power of the *surface* layer in allowing the water to sink down, and preventing it from rising and evaporating, while the second writer only considers the power of the *under* layer in storing water for the use of the plant. Discrimination between soils as suitable or unsuitable is therefore not so simple as either writer suggests, and the soils are of so many kinds and vary in so many ways that no single classification would have much value. Nevertheless, it remains true that some soils are very well adapted, and others very ill adapted, to the retention of moisture.

Adopting the estimate of a mean rainfall of 11 inches as being adequate for the growth of wheat by dry farming in the northern part of the Great Plains area in the United States, comparison with the meteorological records leads to the conclusion that *wheat cultivation may extend throughout the whole of North Dakota and South Dakota and across Montana as far as the Rocky Mountains, except where it is impossible to obtain small additional supplies of water from streams or from underground sources, or where the soils are exceptionally unsuitable.* Further south, the greater heat necessitates a greater rainfall, and the westward extension is likely to be less, but as only a small portion of Nebraska has a mean rainfall of less than 15 inches, it is not improbable that wheat may be cultivated throughout the whole of the state of Nebraska. Still further south, any definite conclusions as to the possibilities fail for lack of data as to the needs of wheat under the conditions of temperature and dryness, but the problem becomes of less practical importance as other crops tend to replace wheat. Here, in regard to rainfall as in regard to heat, the physical factors yield to economic factors in determining the limit of cultivation.

Another semi-arid region, and one where wheat is grown under almost marginal conditions, is the central portion of the Great Basin. In regard to the seasonal distribution of the rainfall this region is intermediate between central California and the Great Plains, for here 40 or 50 per cent. of the rain falls during the period May to October. In Utah crops have

* C. S. Schofield, 'Dry Farming in the Great Basin.' D.A., 1907.

been raised for thirty years without irrigation, and on a mean annual rainfall of 14 inches.* This long record of cultivation refers to the district of Logan, situated near the western base of the Wahsatch mountains and north of Great Salt Lake, but of late years attempts have been made to utilize lands around the irrigated areas which have still less rain. At Leven, south of Great Salt Lake, there has been a very rapid development of dry farming since 1900 on a mean rainfall of 13·6 inches. Still further south dry farming has been carried on at Parowan, where the mean rainfall from 1891 to 1905 was 12 inches, while from 1900, the period during which this cultivation has been pursued, the rainfall has been below the normal in every year but 1905, the mean for this period being 10·5 inches.

The following tables give the distribution of the mean rainfall throughout the year, and also the annual totals for the period of cultivation :—

Mean Monthly Rainfall (in Inches) at Parowan, Utah.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1·0	1·2	1·7	1·3	1·1	0·3	0·8	1·5	0·7	0·9	0·6	0·8	11·9

Annual Rainfall at Parowan, 1900 to 1905.

Year	1900	1901	1902	1903	1904	1905	Mean
Inches	7·5	11·0	9·1	11·8	11·2	13·3	10·5

It is to be noted that this cultivation has been accomplished by the aid of processes directed to the conservation of the soil moisture, but without the adoption of special varieties. The report of Mr. Schofield says : "There are several varieties of wheat in common use both on the dry lands and under irrigation. In fact, there has been little attempt to develop strains or varieties specially for dry lands." Hence, if wheats suited to irrigation can be raised solely on a mean rainfall of 10·5 inches, the drought-resistant varieties could certainly be grown with a still less amount of water.

From these facts certain broad deductions may be made as to the cultivation of wheat in the Great Basin. In the states lying to the north of lat. 45° N. there are only a very few small areas with a rainfall less than 10·5 inches and the larger proportion of the rain comes during the winter; moreover, the temperatures are lower and the relative humidity of the atmosphere is higher than at Parowan. Consequently, there is every probability of cultivation extending over practically all this region.

* C. S. Schofield, *op. cit.*

Note.—In the calculation of mean annual rainfall in the Great Basin, the records up to 1905, inclusive, have been taken. The year 1906 was exceptionally wet; in some places the rainfall for this year was almost twice the mean, and where the records extend only over a few years, its inclusion would be misleading.

In the central part of the Great Basin, between the parallels of 45° and 37° N. (the southern boundary of Utah), the rainfall ranges from only 3 inches at the eastern foot of the Sierra Nevada to over 15 inches in the neighbourhood of the Wahsatch mountains in Utah and in the Parks region of Colorado. Both the rainfall and the relief which determines it are so varied that the land capable of wheat production can be broadly delimited only in terms of rainfall, and from the knowledge hitherto gained, it is only certain that the areas with a mean rainfall of about 10 inches may be utilized. Whether areas with appreciably less than this amount may be brought under cultivation cannot be definitely stated.

In this region, as in the Great Plains area, the need for a small quantity of water for supplementary irrigation is great, and may determine the actual limits of cultivation.

In the part of the Great Basin south of lat. 37° N. the rainfall is on the whole less, while the relative humidity of the air is lower and the temperatures higher than in the central portion. Under these conditions, the growing of wheat without irrigation is not likely to be attempted, except in a few small and specially favoured localities.

A comparison between the conditions in the central part of the Great Basin and those in the northern part of the Great Plains gives some data for reviewing the conclusions made above as to the requirements in the latter region.

The fact that in Utah only 40 to 50 per cent. of the rainfall comes in the hotter six months, while about 70 per cent. is received in the same period in the Great Plains, suggests that a greater annual total would be required in this region; on the contrary, a comparison of the temperatures at Modena, near Parowan, with those at Dickinson (given above) shows that the temperatures at Dickinson are lower than those in Utah, and suggests that a less annual rainfall is sufficient in this part of the Great Plains.

MEAN MONTHLY TEMPERATURES (DEG. C.) AT MODENA, NEAR PAROWAN, UTAH.

Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
−1	−3	2	7	12	19	21	21	14	11	4	−2	9

It appears, therefore, that the differences in regard to the seasonal distribution of the rain and the temperatures in the two districts are not great and tend to negative one another.

A greater difference is observed in regard to the relative humidity of the atmosphere. The following table gives the humidity at Salt Lake City, where the conditions are approximately equal to those at Parowan, and at Miles City in Montana:—

Comparison shows that throughout the year there is considerably lower relative humidity in the Great Basin, and that the difference is most marked in the summer months. It is highly probable, therefore, that less rain

would suffice in the northern part of the Great Plains than in the central part of the Great Basin, or, in other words, that less than 10·5 inches would be adequate under the conditions in the northern part of the Great Plains.

Relative Humidity (Per Cent.) in Utah and Montana.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Salt Lake City	72	67	57	47	45	37	32	33	36	47	58	68	50
Miles City ...	81	82	78	67	61	63	55	54	61	68	76	80	69

Hence the conclusion reached above that 11 inches would be sufficient is justified; indeed, it would appear to be an over-estimate rather than an under-estimate of the requirements in this area; consequently the statement as to the possibility of the extension of wheat cultivation over the whole of the northern part of the Great Plains is confirmed.

The future of irrigation is almost beyond the scope of this inquiry. It may be noted, however, that the additions to the irrigated areas will be very small in comparison with the additions to the arable lands already discussed. For example, the projects which have been either undertaken or considered feasible by the Reclamation Service of the United States will deal only with about 5 million acres, whereas the western half of the State of North Dakota, only a small portion of the land on which dry farming may be pursued, has an area of more than 10 million acres. A further point is relevant to this inquiry—dry farming may be carried on just beyond the margin of these irrigated areas, the farmers being safeguarded against loss by having some land under irrigation, and also the necessary supplementary water-supply described above may be obtained from the irrigation channels. Hence the extension of irrigation will probably lead to some extension of dry farming.

Conclusion.

From these considerations as to the control of wheat cultivation by temperatures and rainfall, it is obvious that an enormous extension of the area will occur; but it is impossible to express this in a numerical form, for there are not sufficient data regarding the probable proportion of these new lands which will be actually productive. Within the regions indicated above, certain areas will doubtless be found unsuitable for cultivation, other areas will be retained for pastoral purposes, and the arable land will be in part devoted to other crops.

Consequently it is impossible to estimate the ultimate total production of wheat in North America, but two facts are clear: first, that the total acreage will be very much greater than it is at present, since it may be extended into the colder regions in Canada, and into the drier regions both in Canada and in the United States, as indicated above; second, that the yield per acre on the lands at present cultivated will increase as a

result of scientific investigation and its application by farmers, and although the yield on the semi-arid lands is likely to be less than on the better-watered lands, even this lower yield may exceed the average yield of the present time. Hence a production double that of the present is quite possible as far as the physical conditions are concerned.

The greatest harvest until now, 1911, was in 1909, when over 900 million bushels were obtained in North America, of which nearly one-fifth was reaped in Canada; it is, therefore, quite possible that nearly 2000 million bushels may be produced in the future, and the proportion coming from Canada may be not much less than that coming from the United States.

Whether the economic factors will make such a production profitable and therefore commercially possible, will depend not only upon the future conditions of production in North America itself, but also upon the future conditions of demand and supply of this commodity in the other great wheat-producing and wheat-consuming regions of the world.

NOTE.—The writer wishes to acknowledge the great kindness of the experiment station investigators mentioned in the footnote references, who either sent information in the form of reports or answered particular inquiries relating to their work.

Prof. MYRES (before the paper): Before I ask for any discussion on Dr. Unstead's paper I should like to read a letter from Mr. Mackinder, who hoped to have been able to be here this afternoon:

"I am very sorry indeed that I cannot be present when Mr. Unstead reads his paper this afternoon, otherwise I should have had great pleasure in announcing that the University of London have resolved to confer the Degree of Doctor of Science on Mr. Unstead in respect of his geographical work so soon as the thesis which he is to read this afternoon has been published. Mr. Unstead has worked for a long time under circumstances which rendered somewhat difficult his devotion to research, and as one of his examiners, I would like to congratulate him very heartily on his success."

I am sure one of the first things we ought to do is to endorse that congratulation, and to express to Dr. Unstead our appreciation of the way in which the University of London has received his work.

Mr. R. H. CURTIS (after the paper): I have listened with very much pleasure to the paper, and I congratulate Dr. Unstead on the labour he must have expended and the results obtained. I have done a little in connection with this question of accumulated temperature. I was led to take it up first of all from some observations I had placed in my hands on the date of flowering of an almond tree year after year. These, however, were only tentative experiments, but they led me a little further to consider what had been done with regard to the time required to ripen wheat and the general application of accumulated temperatures. The fault which I think Gilbert made in carrying out his investigations was in taking a fixed date arbitrarily chosen, and calculating the accumulated temperature from that date to the time of harvest. What I did myself was to begin at the actual date when the wheat was sown, and I took into consideration not only the accumulated temperatures above the critical point, 42°, but also the amount of accumulated temperature below that point; and although afterwards I did not carry on that part of the

investigation, yet I did work out the accumulated temperature above 42° for the succession of years for which Rothamsted data were available. Another weak point I thought in Gilbert's work was that with the Rothamsted dates for sowing and reaping he had used the temperatures obtained at the Greenwich observatory, and as the two places are a considerable distance apart, it by no means followed that the conditions were the same at each. The results I obtained showed a very satisfactory agreement, and Dr. Unstead has quoted from a paper of mine what the general result was. In one particular case, where the difference from the mean result was largest, I tried to find out whether there were other circumstances which might account for it. I turned at once to rainfall, and found that the total rainfall for the period differed very little from the average. But when I looked more closely to the *distribution* of rainfall, I found that whilst January had been a month of excessive rainfall the summer had been a very dry one, and I have little doubt that in that instance the unusual distribution of the rain explained the abnormal difference in the amount of temperature required to ripen the wheat. I do not know that I have anything further to add, except that I have since then carried out some computations from data obtained in the neighbourhood in which I live. I have obtained the dates of sowing and reaping wheat from farmers who live near, and have taken rather a different line in getting my accumulated temperatures. Instead of calculating them from the maximum and minimum temperatures for each day, as before, I obtained them by integrating the records of a sensitive thermograph, and I was agreeably surprised to find how very closely the results approximated to those I obtained for Rothamsted. There was a slight difference in my mean results, which I put down to the difference of elevation of the two places. Both duration of light and the amount of rainfall appear to be very important factors which I think ought to be considered in connection with any discussion of accumulated temperature, because they no doubt very materially influence the time required to mature the wheat.

Mr. W. P. Rutter: I have very great pleasure in congratulating Mr. Unstead on the excellence of his paper. In my opinion, each breed of wheat requires its own number of day-degrees, and wheat-breeding is certain to extend the wheat areas farther to the north. The number of day-degrees required by each variety when sown both in winter and spring might yield some interesting results. The effect of sunshine is a factor that needs working out more fully. There is no doubt that sunshine decreases the necessary number of day-degrees, and improves the quality of wheats in northern tracts. Russian investigators say that breeds of wheat in the north develop early ripening habits. Fuller investigation into the effects of moisture in the air and in the soil in retarding or quickening the growth of plants is needed. A problem which faces American agriculturists is that of combining "strength" with high yield. Recently Prof. Biffen, of Cambridge, has produced wheats which combine the "strength" of Canadian Fife with the high yields known in England. A piece of research work which would prove very valuable is whether it is possible to fix a correct base-temperature as a starting-point for calculations on temperature conditions.

Mr. J. Wrigley: There is one question I should like to ask. I have heard that the best wheat is grown near its most northern limit of production. That is a very important matter, and it would be useful to hear Dr. Unstead's opinion in view of the settlement up of Canada. No doubt the sunshine and the rainfall have an important effect upon the growth of wheat, but I have not heard anything mentioned about the frost. I should like to hear his opinion upon the result of the frost upon the ground. We speak about the cold in these northern regions, but the question is whether that is not doing a very useful work.

Mr. A. E. Kitson: In this important paper, with its interesting conclusions, Mr. Unstead has dealt ably with the poleward extension of wheat cultivation, and shown us the zone in America beyond which the cultivation of that cereal is not probable under present known conditions. The equatorward extension, however, is the aspect of this subject that appeals specially to me, and on which I seek information. Of the regions dealt with in the paper, the Australian ones—Wycheproof, Victoria, lat. about 36° S., and Coolabah, N.S.W., lat. about 31° S.—which I know personally, have conditions of temperature probably most nearly approaching those of the semi-arid tropics. During the latter part of the growing season the country experiences high temperatures, sometimes well over 100° F. (37·7° C.) in the shade, with occasional hot winds and frost. In the tropics, speaking generally, the variations of temperature are neither so great nor so rapid as they are during parts of the year in the temperate and sub-polar zones; besides the mean temperature is not so high in many parts of the tropics, even at low altitudes in them. A personal acquaintance, extending over several years, with West Africa between lat. 4° and 9° N. has struck me with the fact that the average temperature there is lower than in temperate Australia during the hot season, and there is an absence of hot winds. The climatic and physical conditions of many portions of Southern Nigeria appear to be suitable for the growth of wheat, while the soil certainly is so. In those portions during the tornado, rainy, and early dry seasons—those best suited for the growth of a cereal, such as wheat—the night mean temperature may perhaps be taken as 64° Fahr. (17·7° C.), and the day mean temperature as 110 Fahr. (43·3° C.), if small allowance be made for diminution due to clouds and mist, with a diurnal mean of 87° Fahr. (30·5° C.). As regards Australia, my difficulty is to arrive at the approximate accumulated temperature from a consideration of the temperature and the period of growth. It appears as if the accumulated temperature should be higher than the highest given in Mr. Unstead's table of the temperate and sub-arctic zones of the Northern Hemisphere. Assuming that in a tropical country such as Southern Nigeria, with its almost equal diurnal divisions of light, an accumulated temperature of from 1800° to 2000° C. is necessary, then the period of growth of wheat there might be taken as from 59 to 67 days, as compared with 108 days at Ottawa. I should be pleased to have Mr. Unstead's opinion if such an assumption is reasonable. Since wheat can be grown in the highlands of British East and Central Africa almost under the equator, and in India, it seems to me probable that it can be grown also over large portions of Northern Nigeria and the uplands of Southern Nigeria. The annual rainfall in such districts in Southern Nigeria may be taken as from 40 to 60 inches (in Northern Nigeria much less), while that during the possible growing season is perhaps from 10 to 20 inches less. Would this be too high an amount of moisture for such a plant as wheat, the quality of the grain being reduced and the straw increased? It would be interesting to have careful experiments carried out in suitable localities and with due consideration of local conditions. Could a wheat-growing industry be established it would be a great boon to the people of West Africa, quite apart from any possible advantage to the world in general. The natives like wheaten foods, and would certainly grow and eat wheat should it prove adaptable to the country and be economically producible in quantity. It might in Northern Nigeria replace to a large extent the less valuable millet now grown there, while in Southern Nigeria it could materially supplement the staple foods—cassava, yams, and maize.

Another point—has the formation of frost been prevented by the widespread cultivation of areas in frosty regions, or only in those on the margin of the frost-line or zone?

Dr. Unstead: It is rather a pity from one point of view that I have not been

able to read all the paper, because several points that have been raised might then have been settled. For example, in regard to the breeding of varieties of wheat which require less heat, and the suggestion that each variety would require a different accumulated temperature, in my inquiry I considered in each district the variety best suited to the local conditions; consequently, the varieties that have been specially bred are the ones dealt with when regions on the margin of cultivation were considered. Thus one reason why a less accumulated temperature has been required at Sitka than at Ottawa is that the newly introduced and newly bred varieties were considered when the figures for Sitka were calculated, whereas the old established Red Fife was the variety on which the Ottawa figures were based. But I agree that future breeding is likely still further to reduce the number of day degrees necessary in any given region, and that in consequence the limit of cultivation will be pushed further to the north; that possibility is indeed suggested at the end of the first part of the unabridged paper.

As regards the effects of sunshine and other factors in addition to heat, I have attempted a geographical and not a physiological study. Many factors would, of course, have to be taken into account if one inquired into the matter from the point of view of the plant physiologist; the varying efficiency of different temperatures and the changes in the optimum temperature were specified in the paper, and the other factors there referred to include soil temperatures, soil moisture, atmospheric moisture, and the supply of various plant foods. Here, however, my figures relate to conditions extending over many years and wide areas, so that abnormal conditions in regard to the last-named factors are likely to be cancelled one against the other, and the factors which vary most widely from place to place, namely temperatures and duration of sunshine, can be considered in a broad but not detailed manner. Hence, allowing a certain margin of error, the results may have a geographical value, though they may have no value for the botanist, who deals with the exact effects of specific influences. Perhaps the margin of error might have been allowed for, if a band rather than a line had been drawn upon the map to show the limit of wheat cultivation.

The question of the quality of the wheat grown in northern latitudes is beyond the scope of the present inquiry, but it may be stated that the more rapid ripening in the north is accompanied by the formation of grain which has a higher proportion of nitrogen, and therefore presumably is more nourishing.

As I stated at the beginning of the paper, I have not considered the equatorward limits of cultivation from the point of view of the maximum heat conditions, for I doubt whether that is likely to be a problem of practical importance. For instance, in regard to the region on the margin of cultivation in Australia, a letter from the Department of Agriculture in New South Wales says, "The conditions which as yet have determined the limits of wheat cultivation in this country are (*a*) the presence of loamy soils which are suitable, and (*b*) the rainfall." Of course, great heat intensifies the need of water, and an exceptionally hot wind may actually wither a crop, but the chief control is rainfall.

Similarly, in regard to wheat cultivation in Africa, the adoption of the methods of "dry farming" may lead to the development of wheat cultivation on the plateaux. I think it is probable that this will occur on a relatively small scale, and, as suggested, for home consumption, but whether it will be on a large scale for the world market is an economic question. The great extension that is certain in the cooler regions in Canada and Siberia will militate against development in these hotter regions, and here the growth of other plants requiring higher temperatures is likely to be a more economical way of utilizing the natural conditions.

As to wheat cultivation in Nigeria, such indications as can be drawn from the experience of temperate regions point to the conclusion that the heat is there too

great. For example, the Canadian Experimental Farms report for 1893 describes how at Brandon a temperature of 104°–107° Fahr. in the shade on a particular day in August injured the wheat, so that the yield which was estimated at 25 bushels was reduced to 14 bushels. Also, Detmer gives the *maximum* temperature for germination as 42·5° C. (108° Fahr.), and W. Carruthers, in the *Journal* of the Royal Agricultural Society for 1892, writes, "A seed of wheat will not grow unless the temperature is 10° above freezing, while a heat of 104° Fahr. kills it." Comparing these temperatures with Mr. Kitson's statement, that the *mean* day temperature of the most suitable season in Nigeria is 110° Fahr., it would seem that there is little likelihood of the growth of wheat in this part of Africa.

A letter from the Department of Agriculture of New South Wales has given me the mean temperatures at stations in the semi-arid region, and the highest of these mean temperatures to which wheat is exposed are those at Bourke, where they rise to 71° Fahr. in October and 78° Fahr. in November, and the wheat ripens *early* in November. At Wagga Wagga there is a mean temperature of 68° in November and 74° in December, and here the wheat ripens towards the end of November. These mean temperatures lie well below the mean temperature of 87° Fahr. which Mr. Kitson estimates for Southern Nigeria. As to India, the Punjab harvests are completed in May, when the mean temperature has risen to about that mentioned as applying to the whole season in Nigeria, while in the United Provinces the wheat is cut about the beginning of April at a mean temperature which has not risen to 80°, and in the Central Provinces the harvest occurs at the beginning of March, when the mean temperature is about 75° Fahr. In none of these cases, therefore, is the wheat grown with the temperatures as high as those of Southern Nigeria.

In regard to the suggested extension to Australian conditions of my method of calculating the accumulated temperatures, I may say that I have already considered the matter with the following result. The wheat is largely sown in May, and remains in the ground during the coldest months, ripening about November or December. Consequently it is to be compared with our winter wheat rather than with the spring wheat, on which I have based my calculations, but nevertheless the method may be applied to wheat grown under these conditions. The accumulated temperatures experienced are greater than most of those shown in Fig. 3, for the period of growth is longer; but the index numbers are also greater, partly because the days are shorter and the proportion of darkness therefore greater. Consequently, crosses put upon Fig. 3 to show Australian conditions would lie in the top right-hand corner, and although they are not to be taken into account in determining the requirements of spring wheat, yet they confirm the general method here adopted. I may add that the conditions in India show similar results, for both the accumulated temperatures and also the index numbers are considerably greater than those relating to North America and Europe. As I do not think the heat conditions in Nigeria are suitable for the growth of wheat, I do not think my method of calculating the required accumulated temperatures can be applied to that region.

In referring to the disappearance of frosts from regions now taken into cultivation, I was dealing, not with the frosts of late autumn and winter, but only the "summer" frosts that come quite early in the season before the mean temperature has fallen below the ripening point. The evidence shows that the southward margin of the region where these *early* frosts occur has been pushed steadily northward with the widespread cultivation of the land.

Prof. Myres: I am sure it will be the wish of the Committee to express its very hearty thanks to Dr. Unstead for his paper, and for the discussion to which it has given rise. As he has explained himself, he has had to cut down the paper to a consideration of a few special aspects of the problem and one special region, but I hope

that sometime the Committee may take the opportunity of considering other aspects and other regions under his guidance. One thing that suggests itself very strongly in listening to his paper is that a great deal more work of a strictly geographical kind is rapidly becoming practicable now that the plant-physiologists have elaborated their data. They know what to look for and what conditions are important, and now that experimental stations are coming into existence in different parts of the world geographical comparisons can be made. One of the objects of this Committee is to encourage properly qualified observers to enter upon such work as is likely in the immediate future to be of value, and to afford them facilities for co-operating with one another. I will ask the Committee to express its thanks to Dr. Unstead for his paper.

OBSERVATIONS ON THE SIR SANDFORD GLACIER, 1911.

By HOWARD PALMER.

In a previous issue of the *Journal*, the writer gave some account of the topographical features in the vicinity of Mount Sir Sandford, British Columbia, and especially of the glacier having the same name which covers a considerable area immediately to the west of the mountain. During the past summer it was his privilege to make another journey into that region, in company with Professors E. W. D. Holway and Frederic K. Butters, of Minneapolis. The objects in view were mainly those of the mountaineer and explorer, but at the same time it was aimed at to accomplish such scientific work as was not inconsistent with these ends. In particular, it was desired to make additional observations upon the Sir Sandford glacier, which the previous rough measurements had shown to be of some importance in the range, and therefore deserving of a more careful examination. The present paper embodies the results of these observations. In fairness to my associates, it should be stated that for the conclusions here presented the writer is alone responsible. A portion of the field work, however, obviously required the co-operation of all, and it may be said at once that in this my companions' generous advice and assistance were quite beyond acknowledgment.

The instrumental equipment for the work comprised a light transit reading to 5′ of arc, a tape for the measurement of the base line, a camera fitted with a good level and a tripod suited to both transit and camera. The difficulties of transport and distance from a base (supplies depended upon porterage in relays) limited the outfit to the simplest appliances, but it was hoped by using especial care, and by repeating the observations a number of times, to obtain results of greater accuracy than such crude equipment would ordinarily afford.

The work on the glacier may be conveniently considered under the following headings: (1) Measurement of the rate of surface flow; (2) Measurement of the average rate of retreat of the forefoot for one year; (3) Mapping the tongue, streams and moraines; and (4) General observations on surface features, etc.

1. *Measurement of the Rate of Surface Flow.*—To establish a line on the ice, the transit was set up over a stone firmly embedded in the crest of the east lateral moraine at base Camp station, and sighted on the sharp vertical edge of a large boulder in the stable moraine across the glacier. For marks, dark coloured, thin, flat stones having one edge straight were selected and carried out on to the ice. At suitable points flat-bottomed niches were cut, and in these the stones were set with the straight edges on the vertical hair of the telescope. In choosing such stones, it was aimed to take advantage of their tendency to melt into the ice, and thus to remain *in situ*. Over the moraine-covered section of the glacier the line was painted on favourably situated stones. Twenty points were marked in this fashion on June 24, vertical angles being read to each.

Four days later (June 28) the instrument was again set up at Camp station, and the line redetermined on the ice which had meanwhile moved into position. Behind each stone an ice axe was adjusted in the proper position according to the transit-man's signals. The distance to the fiducial edge of the stone was then taken with the tape. For computing the horizontal distances of the stations from the instrument, a short base was measured thence along the eastern moraine, and readings were taken to each stone from its extremity. These distances, combined with the vertical angles ascertained as above, furnished the data for the profile of the glacier on the accompanying map. On July 8, fifteen days after the stones were set, measurements to the original line were again read off. The results of all these operations are given in the table on the following page.

In a broad sense, the figures may be taken as harmonizing with the accepted laws of glacial motion, though perhaps they do not form as clear an illustration as might be desired. Very probably a situation further removed from the disturbing effect of the terminal ice-fall would have been preferable. The essentially uniform increase in the rate of motion from the margin to the maximum at Station 14 appears normal; but the fact that this point occurs nearly at the centre of the line raises a difficulty, for we are dealing with a glacier flowing on a broad curve, where the zone of greatest motion is usually to be found near the convex side. However, it is likely that this complication is more superficial than real, and that if the line were moved back so as to transact a greater amount of ice, and the measurements were continued to its extremity, the ordinary relation would be evident.

The absence of a correspondingly uniform decrease in the rate of motion toward the northerly margin may reasonably be accounted for by the influence of the tributary, by the proximity of the ice-fall, or by both of them. From Station 16 to the margin the ice was considerably crevassed, and beyond number 20 it sloped so rapidly that stations could not easily be brought into the field of the instrument for observation.

The lack of agreement between the columns giving the mean daily rates for four days, for eleven days, and for fifteen days suggests the presence of cross currents and variations in the character of the surface upon which the glacier rests.

OBSERVATIONS ON A LINE OF STONES SET ACROSS THE SIR SANDFORD GLACIER, JUNE 24, 1911.

Stations	Distance from east margin of glacier.	Motion from June 24–28.	Average daily motion from June 24–28.	Average daily motion from June 28–July 8.	Motion from June 28–July 8, 11 days.	Motion from June 24–July 8, 15 days.	Average daily motion for 15 days.	Remarks.
	On Moraine or on Moraine-covered Ice.							
	ft.	ins.	ins.	ins.	ins.	ins.	ins.	
Camp	350	0	0	0	0	0	0	
1	215	0	0	0	0	0	0	On stable moraine, probably not underlain by ice.
2	108	0	0	0	0	0	0	
3	0	0	0	0	0	0	0	Close to margin.
4	68	3	0·75	0	0	0	0	On edges of crevasse. After first measurement they slipped down and could not be replaced accurately.
5	120	2·5	0·63	0	0	0	0	
6	183	7·0	1·75	1·31	14·5	21·5	1·43	
7	274	4·0	1·00	1·50	16·5	20·5	1·36	A backward sliding is likely here.
	On Clear Ice.							
8	431	13·0	3·25	3·12	34·5	47·5	3·16	
9	515	18·0	4·50	5·00	56·0	74·0	4·93	
10	622	21·0	5·25	4·81	53·0	74·0	4·93	
11	714	22·5	5·63	6·36	70·0	92·5	6·16	
12	780	22·0	5·50	7·00	77·5	99·5	6·63	
13	836	22·0	5·50	6·45	71·0	93·0	6·20	
14	884	29·0	7·25	6·54	72·0	101·0	6·73	Maximum.
15	1000	29·0	7·25	6·00	66·0	95·0	6·33	
16	1053	28·0	7·00	5·61	61·75	89·75	6·00	In more or less broken ice; one on a serac. Glacier cascades over a cliff 100 yards below these stations.
17	1131	22·0	5·50	6·36	70·0	92·0	6·13	
18	1196	22·0	5·50	6·13	67·5	89·5	5·96	
19	1230	19·0	4·75	6·68	73·5	92·5	6·16	
20	1445	12·0	3·00	7·18	79·0	91·0	6·06	
Margin	1600							

Approximate width of glacier on line of measurement, 1600 feet.

The close correspondence between the average maximum rates of motion of the three Selkirk glaciers which have been studied is worthy of note. During a period of ten days in the midsummer of 1906 the Asulkan glacier averaged 6·7 inches per day,* while the Illecillewaet,

* *Canadian Alpine Journal*, vol. 1, p. 147, 'Glacier Observations,' by George Vaux, Jr., and William S. Vaux.

I.—LOOKING NORTH-WESTERLY UP SILVERTIP GLACIER. SILVERTIP NÉVÉ LIES IN THE OPENING TO THE LEFT BETWEEN THE TWO PEAKS. SIR SANDFORD GLACIER IN FOREGROUND.

II.—PANORAMIC VIEW OF TONGUE OF SIR SANDFORD GLACIER, LOOKING WEST. SILVERTIP GLACIER ENTERS AT THE RIGHT.

III.—THE MAIN ICEFALL AND UPPER 3 MILES OF SIR SANDFORD GLACIER, LOOKING SOUTH. ALTITUDE OF COL IN RIGHT DISTANCE IS ABOUT 8100 FEET.

IV.—SILVERTIP NÉVÉ, LOOKING SOUTH-WEST. WITH THE GLACIER OF THE SAME NAME WHICH ENTERS AT THE RIGHT, THIS FORMS THE SECONDARY SOURCE OF SIR SANDFORD GLACIER. ALTITUDE OF FLOOR LIES BETWEEN 7500 AND 8000 FEET. LENGTH ABOUT $2\frac{1}{2}$ MILES.

in 1899, at the same season averaged 6·79 inches * for the longer interval of thirty-six days. The Sir Sandford glacier, as noted above, showed a rate of 6·73 inches for fifteen days.

The weather, during the time that the glacier was under observation, was almost continuously cloudy and rainy, with an average minimum temperature of 36·7° F. Accordingly the table doubtless indicates less than the usual summer activity.

The Sir Sandford is in some respects an awkward glacier to study. It lacks a pronounced demarcation between the forefoot and the northern margin and the terminal cascade with the attendant crevassation of the ice for some distance up stream introduces difficulties in field work. It is probable that the true tongue extends westerly as far as the end of the medial moraine from Silvertip glacier, though indications point to a substantial stagnancy of the ice at this point. Future workers will doubtless find that a line between Base station and Signal station will offer the most advantages for carrying out observations on the surface flow.

2. *Measurement of the Average Rate of Retreat of the Forefoot.*—In 1910 the writer made an attempt to secure suitable views for a map of the tongue, but, owing to the extensive braid of streams which traversed the moraine about the tongue (see 1910 view, plate VI.) and the amount of water they carried, it was found to be impracticable to reach a satisfactory station, and was finally abandoned. However, a three-leaved panoramic view of the glacier was taken from Station 1 on July 16. When compared with a similar series exposed from the same point on June 30, 1911, a marked retreat of the ice is noticeable. With a print of the earlier photograph in hand, the rocks numbered 6, 9, 10, 3, 11, 1, and 13 were identified, and their distances from the nearest ice were measured off with a tape. Combining these with the estimated distances of the rocks from the ice in 1910, as shown on the photograph of that year, the intervening retreat was obtained. The results appear in the following table :—

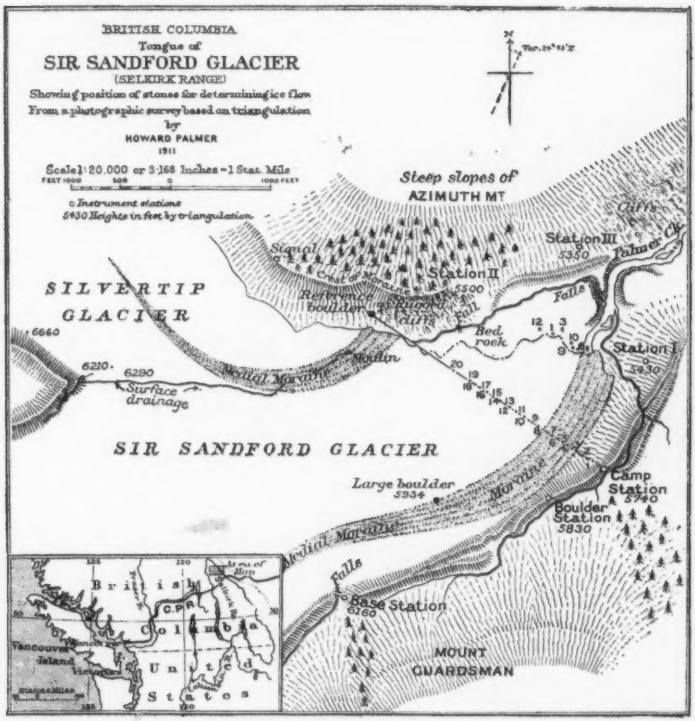
OBSERVATIONS FOR THE RECESSION OF THE FOREFOOT.

Rock No.	Measured distance from nearest ice, 1911.	Estimated distance from tongue, 1910.	Mean retreat for 50 weeks.	Average recession for 50 weeks, 1910–1911.
	ft.	ft.	ft.	ft.
6	50	5	45	46
9	47	0	47	
10	33	0	33	
3	28·5	8·5	20	
11	28	0	28	28·6
1	27	5 back of tongue	32	—— 37·3
13	40	10	30	

(These rocks were not marked. Identification depends on the photographs.)

* *Appalachia*, vol. 9, p. 160, 'The Great Glacier of the Illecillewaet,' by George and William S. Vaux, Jr.

A small moraine a little distance ahead of the most advanced ice may be distinguished in the 1910 view. This indicates the position of the forefoot in 1909. By measurement with the tape this was found to be 25 feet from the position of the ice there shown, which accordingly represents the amount of the retreat for 1909-1910 at this point—a close agreement with the 28·6 feet as shown in the table for 1910-1911.

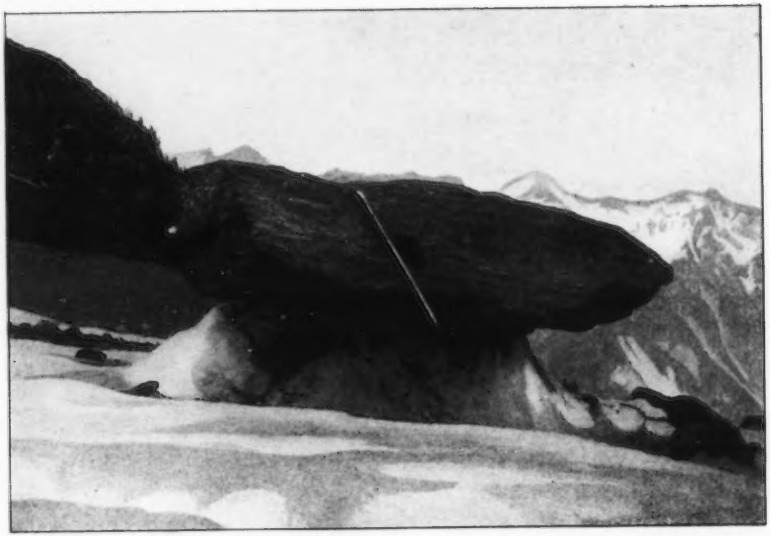


Section of Glacier on Line of Stones
Horizontal scale twice the scale of map
Without any exaggeration of the vertical scale

Other differences apparent from the photographs are an increased elevation or thickening of the ice towards the centre of the glacier, manifest upon a careful comparison of the profiles, and the new courses of the main drainage channel. The stream abandoned its lateral exit to issue in full volume from the foot of the final ice slant. It would seem

V.—TEST PHOTOGRAPH OF TONGUE OF SIR SANDFORD GLACIER TAKEN FROM STATION I., JUNE 30, 1911.

(Photo, Howard Palmer.)



VI.—GLACIER TABLE ON SILVERTIP GLACIER.

that only a subglacial change of considerable moment could be accountable, for the stream had occupied its former bed sufficiently long to erode a decided channel in the ground moraine and pronounced niches in the brink of the gorge into which it plunged. It will be of interest to note whether an ice arch will form above the new outlet. Conditions appear favourable, for this is the thickest portion of the forefoot. The stream is about 40 feet wide where it emerges from the glacier. It is heavily charged with rock flour, and correspondingly turpid in appearance. The final slope of the tongue is about 25°.

Little time was available for work with regard to the position of the ice at an earlier date. At Camp station two prominent well-defined moraines exist, between which a lateral stream flows. On the most westerly, overlooking the ice, a spruce 7½ inches in circumference was cut down. This showed thirty-seven rings of growth, and was the oldest, apparent, on casual observation, anywhere near by on the ice side of the moraine. It occupied a position fully exposed to northerly winds, and was one of a very few specimens. On the easterly slope of the moraine, in a more protected place, another spruce showed thirty-one rings. It is safe to say that this moraine is more than fifty years old. On the easterly moraine, overshadowed by the mature evergreen forest of the valley slope, were noted a spruce with sixty-three rings, and a fir with fifty-three. This would seem to indicate an age of over seventy-five years for the easterly moraine. All these specimens were taken within a hundred paces of Camp station.

3. *Mapping the Forefoot, Streams, and Moraines.*—The accompanying map is based on instrumental triangulation, supplemented by photographic panoramas and single views. (The stations from which the latter were taken are outside the limits of the plan.) The base line is not shown, as the triangles covering the area mapped are part of a larger system. All stations except Station 2 and Signal station were occupied with the transit and their positions, and altitudes depend upon its readings. Stations 1, 2, and 3 served as camera stations, whence panoramas of the tongue and adjacent detail were taken. They consist of prominent boulders, or ledges, and were marked conspicuously in dark green paint, 2 and 3 with signal targets.

The points limiting the margin of the ice, and other prominent features, were determined by intersections from the panoramas according to the methods of photographic surveying. Lateral moraines were paced.

The large boulder indicated on the map at the edge of the surface moraine in the vicinity of Boulder station forms a mark of some prominence. For this reason its position was determined by the transit. On July 8, 1911, it was 1136 feet distant from Boulder station, and 1734 feet distant from Camp station, being 104 feet higher than the former, or at at altitude of 5934 feet. Its diameter was estimated at about 15 feet, which may preserve it from falling into a crevasse. The boulder is well

seen almost exactly in the centre of Plate I. This photograph was taken on July 12, 1910. It so happens that the transit measurements just given were made on July 13, 1911. Upon plotting the azimuth of the boulder as obtained from Plate I., a total motion of 50 feet was read off by the position mapped in the direction of the line representing the border of the moraine. This results in a rate of 1·64 inches per day for the intervening year, which offers an interesting comparison with that of 3·16 inches indicated at Station 8 on the surveyed line, at approximately the same distance from the margin.

4. *General Observations on the Surface Features, etc.*—As a result of the larger triangulation referred to above, it becomes necessary to reduce the length of the main stream of the Sir Sandford glacier from the previous estimate, based on prismatic compass to almost exactly five miles. In like manner a reduction in total length to about twelve miles, and in area to about ten, would probably be warranted. The latter figure refers to the actual area of ice and *névé*. The area of the glacier's drainage basin is far greater. The average slope of the glacier from the pass at its upper extremity to the toe is 570 feet per mile. The altitudes are from triangulation, for which Mount Sir Sandford, at 11,634 feet, served as datum. Names used have been approved by the Geographical Board of Canada.

The line of junction between the Silvertip and Sir Sandford glaciers presents some interesting features to a cursory examination. The two trunk streams meet almost at right angles, and the line of contact for fully half the width of the Silvertip is a straight line (see Plate II.), indicating almost diagrammatically the resultant of their motions. Beyond this point the greater mass of the Sir Sandford begins to tell, and the line is deflected. The unusually regular and delicate curve in the medial moraine of Silvertip glacier also depicts graphically the forces at work in this vicinity. Several good specimens of glacier tables were noted in this moraine. The line just referred to marks the course of the local surface drainage, which flows both ways from a divide in two brooks (see map). One empties into the depression in the corner between the glaciers; the other, a larger stream, into a moulin about as shown on the plan. The streams have sunk their channels as much as 5 feet into the ice at some points, revealing in rather a striking way a number of small crevasses in the walls, which open, perhaps, an inch at the surface of the glacier, but gradually close downward until complete union is effected just far enough above the stream to prevent any escape of the water. Quite a series of these cracks was noted in the south wall of the westerly flowing brook.

Another feature worthy of mention with respect to the junction of these glaciers is the absence of any pronounced medial moraine. A few blocks of ground moraine that apparently had been picked up by the Sir Sandford were seen, but, obviously, these were exceptions. The actual

place of meeting of the ice streams may best be likened to one of the re-entrant angles formed at the corners of a picture frame made out of quarter-round moulding. From the ground moraine the ice rounded up steeply and smoothly on each side without crevasses, forming a depression which the aneroid indicated as being 80 feet below the level of the ice further back on the line of union. The other side of the rough triangle was made up of an unstable pile of lateral moraine. A stream issued from the margin of the Sir Sandford, and flowed into the Silvertip near the junction. A coating of mud on the stones and an ill-defined line on the ice of both glaciers go to show that at times the water rises in the depression to form a lakelet.

A somewhat unusual form of glacier table was exhibited on the side of Silvertip glacier, near the point of meeting. A number of large blocks of pure white snow, apparently the remains of a spring avalanche, had withstood the effects of melting, and, owing to their greater reflecting power as compared with the dirty surface of the glacier, had protected the ice beneath them from the sun to such an extent that they were perched up on distinct pedestals some distance above the normal surface level in grotesque attitudes.

THE ANTARCTIC EXPEDITIONS OF 1911-12.

By HUGH ROBERT MILL, D.Sc.

News of Captain Scott's expedition reached this country on April 2, his ship the *Terra Nova* having arrived at a New Zealand port on the previous day. The information which it is possible to give here is taken from two long telegrams supplied to the press by the Central News Agency, and published on April 2 and 3. There is always some difficulty in interpreting the statements of positions in telegrams, so that it is not possible to be certain on some points of detail, but the general results are clear.

As originally planned, the expedition was to operate simultaneously in four widely different areas: King Edward Land was to be explored by an Eastern party, the great coast range of Victoria Land by a Western party, scientific observations were to be maintained in great detail at the headquarters on McMurdo sound, and a Southern party was to proceed if possible to the pole. The return of the *Terra Nova* a year ago acquainted us with an important change of plan; the Eastern party, being unable to land on King Edward's Land, had proceeded to Cape Adare, whence exploration was to be carried on along the coast on the sea ice.

The news now received carries on the history of the expedition to March 5, 1912, and we may state briefly the result of the year's labours of the four separate parties so far as these can be given.

The number of men at the headquarters at Cape Evans on McMurdo sound varied according to the coming and going of various parties; but

during the greater part of the time, in the absence of Captain Scott, it was under the charge of Dr. Simpson, the physicist and meteorologist, under whose competent management the scheme of scientific observations was carried out with very exceptional completeness. Continuous records of temperature, pressure, and of wind direction and force were obtained from self-recording instruments checked by eye observations every four hours. These will prove most valuable in clearing up such doubtful points in the meteorological work of the *Discovery* expedition as were not fully elucidated by the *Nimrod* expedition, and they have also a special value on account of the similar observations carried on simultaneously at Cape Adare by the Northern party and at the east end of the Barrier by Captain Amundsen. For the first time in the Antarctic regions the upper atmosphere has been investigated by means of balloons, which have shown the direction of the upper currents to a height of 6 miles, and the temperature of the air up to 5 miles. Self-recording magnetic instruments were kept at work in an observatory excavated in the side of a glacier, thus securing uniform temperature throughout the year, which is essential to accurate observations. Atmospheric electricity was also studied and the aurora observed. The results promise to be of the greatest value, and as Dr. Simpson has returned with the *Terra Nova*, we may hope soon to hear details.

A novel and daring feat in Antarctic travel was undertaken in midwinter by Dr. Wilson, Lieut. Bowers, and Mr. Cherry Garrard, who started on June 27, 1911, on a journey across the Barrier to Cape Crozier in order to study the incubation of the Emperor penguins, which breed in the winter. The party were absent for five weeks, and in spite of terrific weather, with frequent blizzards, the thermometer being seldom higher than 60° below zero and once falling to −77° Fahr., the long moonlight expedition was as successful as it was unique, and none of the party was the worse for it. We have no hesitation in saying that the work from headquarters was an unqualified success and enough to make the reputation of any expedition.

The Northern party under Lieut. Campbell, included Dr. Levick, Mr. R. E. Priestley the geologist, two petty officers, and a sailor. They landed at Cape Adare on February 18, 1911, and their experience was very similar to that of Mr. Borchgrevink at the same place in 1899. Like him they experienced terrific gales, carrying away their anemometer; and like him they were unable to find fast sea-ice to travel over, or apparently to make a way up the mountains to the plateau. They kept up meteorological and magnetic observations, and on January 4, 1912, were taken off by the *Terra Nova* on her return from New Zealand. The ship made efforts to land the party at the most northerly point in Victoria Land, from which they could reach the interior, and on January 8 a landing was made in Terra Nova bay, and Lieut. Campbell's party set out northwards overland with the intention of passing between Mount Melbourne and the

Nansen range, proceeding to the northern extremity of the plateau and returning southward to be picked up by the *Terra Nova* in February ; but that vessel was less fortunate than the *Nimrod* which picked up Prof. David's party in 1909, and could not penetrate the ice-pack of Terra Nova bay, and had to return to New Zealand unsuccessful. No fear need be felt for the safety of Lieut. Campbell and his companions, as seals are plentiful along the coast, and they should experience little difficulty in making their way back to the headquarters on McMurdo sound.

The Western Party, consisting of Mr. Griffith Taylor, Mr. Frank Debenham, and two others, spent February, 1911, and the first half of March in a geological survey of the Dry valley, the lower Ferrar glacier, and the Koettlitz glacier on the west side of McMurdo sound. A large stream was found to flow for 25 miles under the Koettlitz glacier and its moraine to the sea, and it was found to be a route frequented by seals. The weather during this trip was much quieter and less severe than at the headquarters of the expedition at Cape Evans on the other side of the strait. On November 7, 1911, this party left the headquarters for Granite harbour on the coast of Victoria Land, where they lived in a stone hut, subsisting mainly on seal meat. Many specimens of wingless insects were found, no doubt similar to those discovered by Mr. Borchgrevink. They ascended the Mackay glacier and reached a prominent nunatak, the position of which is not given, where they found much of geological interest, including bituminous coal "almost certainly derived" from an outcrop of Beacon sandstone on the nunatak. They also found well-preserved fossils which are said to be "probably crustacean," but it is open to conjecture that the geologists may have written "probably Cretaceous." On January 8 the party returned to Granite harbour, and, after waiting for the *Terra Nova* to pick them up until only ten days' provisions were left, they travelled south to the Blue glacier on their way back to headquarters, and here the ship took them aboard on February 15. All their collections, however, were left at Granite harbour, where it is hoped the ship may be fortunate enough to recover them next year. The results of this party seem to have been excellent, and they must have notably extended the geological observations of the *Discovery* and *Nimrod* expeditions in the western mountains.

The strength of the expedition was concentrated on the work of the Southern Party, which was under the personal direction of Captain Scott.*

* The Central News has been authorized to publish the following extract from a private letter written by Captain Scott on October 28, 1911 : " We shall leave for the South with high hopes of accomplishing our object, despite the reverses of last season, but there is a chance that we may not catch the ship, and we have decided to arrange for her return in 1913. I am fully alive to the complication in the situation arising out of Amundsen's presence in the Antarctic, but, as any attempt at a race might have been fatal to our chance of getting to the Pole at all, I decided long ago to do exactly as I should have done had Amundsen not been here. If he gets to the Pole he will be bound to do it rapidly with dogs, and one foresees that success

As in the case of the Northern Party, we are without news of the end of the expedition, and some of the particulars of the proceedings up to the last reports are difficult to follow on the map. After setting up the headquarters at Cape Evans in January, 1911, parties were sent out to the south to prepare depôts for the great southern journey in the following spring. A base camp was first established on the Barrier 7 miles east-south-east of the old *Discovery* headquarters at Hut point, which was 15 miles south of the headquarters and connected with it by telephone, a device which greatly facilitated the work of the depôt-laying parties. A second depôt was established at Corner camp on the Barrier, 27 miles east-south-east of the Base camp, in order to avoid the rough disturbed ice off White island and Minna bluff on the shortest line to the south. By February 16, 1911, Captain Scott and his depôt-layers had accumulated a ton of stores at One Ton camp in 79° 30′ S., apparently due south of Corner camp. Bad weather made it necessary to return to Hut point, but five ponies were lost on the way, two by the severity of the weather and three by the breaking up of the sea-ice. Here the party had to remain until the freezing of the strait made it possible for Captain Scott and a few companions to reach the headquarters at Cape Evans on April 13. Here another pony was found to have died, leaving eight surviving. The last of the depôt-laying party did not get back from Hut point until May 23, three weeks after the sun had set for the winter. On September 1, 1911, the first of the spring parties returned to Hut point to continue the transportation of stores to Corner camp. In order to get the utmost use of the ponies, Captain Scott decided to postpone the date of starting on his southern journey until the season brought milder weather, but the motor-sledges were employed in carrying stores south. The main party, under Captain Scott, left Hut point on November 2, and followed the track of the motor sledges for 60 miles south from Corner camp until the sledges were found abandoned, the system of air-cooling having been inefficient and the engines breaking down owing to overheating; but Captain Scott was quite satisfied with the principle of propulsion, and the sledges were put to rights on the return of the supporting parties some time later. Captain Scott proceeded southward by easy stages of 15 miles per day to husband the strength of the animals. He built snow cairns at intervals of 4 miles as a guide on the return journey, and left a week's provisions in a depôt at each degree of latitude. The surface improved after One Ton camp, and as the party proceeded the ponies were killed as the loads lightened in order to supply food for the dogs. In this way five had been destroyed by the time 83° S. lat. was reached, and after this the weather grew worse. So far as we can follow the route from the bearings and distances given for Corner

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will justify him. Anyway he is taking a big risk, and if he gets through he will have deserved his luck. Meanwhile you may be sure that we are doing the best we can to carry out our plans."

camp, and on the assumption that the course thence was due south, the route seems to have been parallel to that of Sir Ernest Shackleton and about 9 miles further east, his route having been about 25 miles east of that of Captain Scott on the Discovery expedition in order to avoid the much disturbed ice near the land. Latitude 83° 24′ S. was reached on December 4, 1911, and here the weather was very bad, much snow fell, the temperature rose above the freezing point, and the resulting thaw made the surface almost impassable. The food for the ponies having become exhausted, the surviving animals were killed before leaving the Barrier surface.

On December 10 the Beardmore glacier was reached, and Captain Scott ascended to the plateau by it, identifying the mountains discovered by Sir Ernest Shackleton as he passed. The dog teams were sent back by a returning party from the foot of the glacier, the advancing party dragging the sledges thenceforward. On December 21 they were on the plateau 8600 feet above sea-level, at a point 4 miles south and 30 miles west of Mount Darwin. The position is given both by bearings and as in "latitude 85·7 S., longitude 163·4 E.," but as this is almost exactly the position of Mount Darwin, we are inclined to think that there is some confusion in the telegram. The position by bearings indicates a considerable divergence from Shackleton's route, Captain Scott having probably found an easier way which by a *détour* avoided the very trying ice-falls at the head of the Beardmore glacier. The surface was still terribly soft as a result of the thaw. On the last day of the year in 86° 56′ S. a large depôt of provisions was left, and the sledges were rebuilt with new short runners, and on January 4, 1912, in 87° 36′ S., at a height of 9800 feet above the sea, the last supporting party returned, bringing the news that Captain Scott was pushing on to the Pole with Dr. Wilson, Captain Oates, Lieut. Bowers, and Petty-Officer Evans. They were taking provisions for a month, and as they were within 150 miles of the Pole, there was every prospect, given moderate weather, of their reaching that point and returning safely. By deciding not to return the same season, Captain Scott would be freed from the strain of working against time, and he would be able to devote the more time to such scientific observations as the necessary lightness of their equipment permitted. So far as we can judge, Captain Scott's track on the plateau was about 20 miles west of that of Sir Ernest Shackleton, in the latitude of Mount Darwin, but, of course, converging towards it on the way south.

The last supporting party, consisting of Lieut. E. R. G. Evans, Mr. Lashley, and Petty Officer Crean, left Captain Scott and his four companions in excellent health and spirits on January 4 in 87° 35′ S., and made excellent progress homewards to 80° 43′ where Lieut. Evans developed symptoms of scurvy, and at Corner Camp he completely broke down. Crean made a march of eighteen hours to Hut point, where he fortunately met Dr. Atkinson, who went to Lieut. Evans's assistance with a dog

sledge, and conveyed him by a splendid run a distance of 35 miles in five hours. This is certainly one of the smartest pieces of work ever done in the polar regions. Lieut. Evans came to New Zealand on the *Terra Nova*, and hopes to be sufficiently recovered to go south in her again at the end of the year.

Before the *Terra Nova* left, two dog teams, conducted by Mr. Cherry Garrard and Demetrie, had started to meet Captain Scott on his return and facilitate the last stage of the journey.

Lieut. Pennell, in command of the *Terra Nova*, brought back Dr. Simpson, Mr. C. H. Meares, Mr. Griffith Taylor, Mr. Day, and Mr. H. G. Ponting, the photographer, who brings with him a very fine collection of photographs and cinematograph films. He did some useful oceanographical work on the way, and ran a line of soundings from near New Zealand to the edge of the ice.

It would be premature to make any comments on the results of the expedition until the necessarily meagre descriptions of the telegrams are supplemented by letters giving the exact routes followed, and some account of the collections and observations which have been made. We may, however, say that it is a great satisfaction to learn that there was no serious accident to any member of the largest expedition which has ever wintered in the far South, that the general health was excellent throughout, and that Captain Scott's enthusiasm and experience promise the best possible results for his labours.*

ISLAND-NAMES IN MELANESIA.†

By W. H. R. RIVERS, M.A., M.D., F.R.S.

Most of the islands of Melanesia are denoted by at least two different names: one or more, of European origin, given by an early discoverer; another or others, names used or supposed to be used by the natives themselves. A name of European origin is usually given in atlases and charts, and this is generally the name by which an island is known to the outside world if it is known at all. The second kind of name, of native origin, on the other hand, is often that by which an island is known to the officials, missionaries and traders who live on the spot.

The anthropologist—and it is from his point of view that I approach the matter—has to decide which of these two names he will use. He has to mention the names of different places continually, and as he cannot always give two alternatives, he has to fix on one or the other. The natural tendency of the anthropologist, due to his interest in native matters, is to use native names, and this tendency shows itself in anthropological literature. It is, I believe, the general opinion of anthropologists that places should be denoted by native names whenever possible.

There is, further, a political reason in favour of names of native origin. When names of European origin are given to islands by their first discoverers,

* For report on the Australasian Antarctic Expedition, see p. 482.

† Research Department, March 16, 1911. Map, p. 520.

the choice is naturally influenced by the nationality of the discoverer, and if at any time the islands come into the possession of another nation, there is the possibility that these names may be changed, to the great inconvenience of geographers and ethnologists—an inconvenience of which Melanesia furnishes a striking example. It is probable that native names would be less liable to suffer change in this way.

As an anthropologist my own bias is strongly in favour of native names, and it is only very reluctantly that I have been driven by experience to recognize that the native names usually employed are such that their use in anthropological literature can only be a source of confusion.

We have all heard of stories in which names given by early explorers have been founded on the most ridiculous misconception of native utterances. Names which mean "I don't know" or "over there," or which properly denote persons or houses, etc., have been taken to be the native names of places and have come into general geographical use. It is not with such mistakes that I deal in this paper. So far as I know, they have been very rare in Melanesia, but if such names had been given and had come into general use, I should not have quarrelled with them. Their origin may have been absurd, but it is their very wrongness which prevents them from being misleading. The names to which I wish to call attention are due to far less heinous mistakes than those I have mentioned; it is the fact that they nearly approach the truth which makes them the possible source of great confusion.

An instance will make my meaning clear. The Percy Sladen Trust Expedition which went to Melanesia three years ago spent several months on a small island in the Solomons which in the Admiralty chart is called Narovo. When we reached the Solomons we found that the island is generally known as Simbo to Europeans and natives alike. It soon became clear that the island, which, as may be seen in the inset of the map, really consists of two closely connected islands, is divided into four districts, called respectively Narovo, Ove, Karivara, and Simbo, the last-named district corresponding approximately to the smaller island, so that the two names used for the island as a whole are properly the names of two of its districts. These four districts are occupied by four different sets of people, who may well be regarded as separate tribes. Each has its own chiefs and many special features of social institution, while at one time it is clear that warfare took place between them. It is obvious that our attempt to describe the sociology of the island would be seriously hampered if we used what are really the names of districts of the island for the island itself. There would be scope for endless confusion if we were to use as the name for the island either its name of the charts, Narovo, or the name, Simbo, by which it is generally known in the Solomon islands themselves. It is clear that if the surveying officer who was responsible for calling the island Narovo, had called it Umba, which means "I don't know," or even Patukio, which is the name of the mountain in the background of Narovo bay, the mistake would have been far less serious, for these names, wrong though they be, might be used without confusion. It is the fact that the name was so nearly right which introduces the difficulty.

I may perhaps point out here that the modern development of anthropological inquiry has given, and will continue to give, such points of nomenclature enormously greater importance than they have had in the past. The difficulty to which I have referred would not trouble the older type of inquirer who is content to record social life as it appears to himself. The modern movement in ethnology attempts to portray native institutions by giving

concrete accounts of things as they are from the native point of view. To take an instance, a modern ethnologist is not content, or should not be content, to give a general account of the functions of chiefs, but he gives fully the names of the present chiefs, illustrating their descent by pedigrees; he describes as accurately as possible the districts over which their powers and privileges extend, and his account of these powers and privileges is based on concrete records in which actual persons, actual places, actual objects, and actual incidents are utilized as fully as possible. Such a concrete method will come more and more into use in the future, but such concreteness can result in nothing but confusion unless native names, including those of places, are used in accurate and well-defined senses.

I propose in this paper briefly to survey those parts of Melanesia with which I have some personal acquaintance, in order to show that the instance I have recorded is far from exceptional, and I take this opportunity of considering a few other points of geographical nomenclature.

The little island I have mentioned is somewhat exceptional in that both the names by which it is usually known, Narovo and Simbo, are of native origin, but it has also been called Eddystone, though this name belongs more properly to a rock off the south-west end of the island.* Further, we discovered that the natives have a name for their island as a whole, calling it Mandegusu, or "the four districts," a name which thus records one of the most prominent features of the social organization.

A neighbouring island which provides another instance of the same mistake, is usually called Ronongo, but in the most recent Admiralty chart it has been more correctly named Ganonga, the former erroneous spelling having been due to failure to appreciate the peculiar guttural sound usually called the Melanesian *g*. The spelling of the Admiralty chart takes no account of the two sounds for which the letters *ng* are used in English. In this case the sound is that of the *ng* of the English word "finger," and in the accompanying map the word is spelt Ganongga.

As a matter of fact, Ganongga is properly only one of three districts of the island, viz. a district on the west coast, the others being Kumbakotta on the east and Lungga at the southern end. We were only able to make superficial inquiries into the social institutions of this island, and were in consequence little inconvenienced by the fact that the ordinary name of the island is also the name of a district, but if we had made a complete inquiry, or if such an inquiry should be made in the future, the name of the island would have been or will be a source of confusion of exactly the same kind as that actually experienced by us in the neighbouring island. Here we have no alternative name of European origin, while the proper native name for the island as a whole is the somewhat uncouth and long Vesogogoto.

The island usually called Kulambangra presents the same difficulty. Mr. Hocart tells me that this name, properly Kolombangara, is the name of a district. The native name for the island as a whole is nDuke, a shortened form of nDugore, which is also the name of a district, and the existence of two forms enables us to use one for the district and the other for the island as a whole, and Mr. Hocart is anxious to call the island nDuke, thus following native usage.

The next island illustrates very well that mistaken nomenclature is no longer troublesome when the name which has come into general use is wholly erroneous.

* For an account of the history of the nomenclature of the island and rock, see Guppy, 'The Solomon Islands and their Natives' (London, 1887), p. 278.

I have been quite unable to discover how the island of Vella Lavella came to receive this name. One of its districts is called Veala, and the name for the whole island used by the people of certain other islands is Vekavekala, and I can only surmise that the name Vella Lavella is a corruption of the latter word influenced by knowledge of the name of the district. So far as I could discover, the term Vella Lavella is not used by the natives of the island except in so far as they have been influenced by Europeans, and it is certainly not the name of a district, and owing to its non-correspondence with anything native, its use is entirely free from the confusion which arises in the cases already considered.

The island of Choiseul is often known by this name locally as well as by the terms Lauru and Bambatana, which are almost certainly the names of districts.

An island, or rather group of islands, which raises several difficulties in nomenclature is that to which the names of New Georgia and Ruviana (usually incorrectly spelt Rubiana) are usually applied. I did not visit this group myself, but Mr. Hocart tells me that Ruviana is used for an island, for a district of the island, and for a large region, and he would like to use the word without qualification in the last sense, calling the island Ruviana island, and using an alternative native name, Kokorapa, for the district. The eastern-most island, which following the chart I have in the map called Vangunu, is, I believe, more usually known as Marovo, though this term should perhaps be limited to the northern part of the island.

The island called Ysabel by its Spanish discoverers affords an excellent example of the extension of the name of a district to the whole island. This island is known to missionaries and others as Bugotu, a word which in the mouths of the traders has become "Buckatoo," accentuated like the word "cockatoo." This is properly a district at the south-east end of the island, and here again exact ethnological investigation would doubtless make the use of the term a source of serious confusion.

The next island, named by the Spaniards Florida, is generally known as Nggela, which is probably the true name for the island as a whole; but it is interesting to note that when first visited by the Melanesian Mission the name Anudha, found later to be the name of an islet, was taken by Bishop Patteson to be the name of the whole island, and this mistaken name for the island has been perpetuated in the work of Von der Gabelentz.*

The large island of Guadalcanar is generally known by its Spanish name, though it has occasionally been called Gera, which is probably the name of a district at its south-east end.

The term Malaita (sometimes Malanta) is possibly a corruption of the word Mala or Mwala, which is probably the true native name for the island as a whole. Here again, whether Mala be the true native name of the island or not, Malaita is almost certainly a native term, which, like Vella Lavella, departs so far from anything properly used by the natives themselves that it can be used as a geographical name without inconvenience.

The small island at its south-eastern end, called by Surville Contrariété island, is usually known locally by its native name of Ulawa, while an island south of it is known as Ugi.

The large island called by the Spaniards San Cristoval or San Cristobal has been called Makira, Arossi, and Bauro (properly Bwauro); but these are certainly only the names of places or districts on the coast. I am greatly

* 'Abhandl. d. könig. sächs. Gesellsch. d. Wissensch.,' phil-hist. Classe, 1879, Bd. vii. S. 130.

indebted to Mr. F. H. Drew for the chief names of places or districts in this island, which I have given as a second inset of the map.

On passing to the Banks islands and the New Hebrides we find the same state of affairs, though, owing to my short stay in this region, I am not able to give such definite instances as in the Solomons. In the Banks the island called by the Spaniards Santa Maria is usually called Gaua, which is the Mota name for one of its districts, while Motlav is properly only part of Saddle island, though the latter term is often used for the whole. The name of another island of this group, on the other hand, is irreproachable, for Vanua Lava means "the great place," and would certainly never be the source of confusion. Other islands are known both by their native names and by those of European origin, examples being Bligh island or Ureparapara, Sugar Loaf island or Mota, and Star peak or Merlav, while others again, as Rowa and Merig, have only native names.

In the New Hebrides I am unable to give any definite examples of incorrect nomenclature, though there is much doubt whether any of the native terms for the northern islands, Raga, Omba or Opa, and Maewo are names originally used by the people of these islands in the sense which they have now come to possess through European influence.

One instance may be given from a part of Melanesia which I did not visit. Ella * states that the word Uvea or Uea, which is generally applied to one of the islands of the Loyalty group, is properly the name of one end of the island which was inhabited by castaways from Wallis island (Uvea).

The foregoing account makes it clear that the source of confusion which troubled us in the Western Solomons as the result of the use of native names exists widely throughout Melanesia, and I can now turn to the practical problem as to what is to be done by those who have to write and speak about this part of the world, and one of my motives for bringing this subject before this Research Meeting is the hope that I may obtain advice upon this matter.

In the map which is before you I have followed a general rule of giving names of European origin in the first place, with the native names in brackets below or beside them, and it is the names which come first which in general we are proposing to use in our work on Melanesia. Where only one name is given, it indicates in some cases, as in that of Tikopia, that there is no European name; † in others, as in the Banks islands, that the native names are almost certainly correct and so well established that they may be accepted.

I will now again briefly survey the region I have covered from this practical point of view, beginning at the same spot. Since we can be confident that Mandegusu is the real native name for the island hitherto called Narovo and Simbo, I might perhaps be excused for making this an exception to my general rule, and the fact that this name expresses a feature of the social organization of the island affords an additional argument in its favour. It is, however, a serious matter to suggest a new native name, and Mr. Hocart and I are inclined to use the old name of Eddystone island, notwithstanding the fact that it is a question whether it should not correctly be applied to the rock adjacent to the island, and not to the island itself. The neighbouring island, usually hitherto called Ronongo, presents a very difficult problem. If its ethnography is ever worked out completely, as I hope may be the case, the use of the term

* 'Rep. Austral. Ass.,' 1892, p. 634.

† In Arrowsmith's chart, 1832, the island is called Barwell island, after the *Barwell*, which sighted it in 1798.

"Ganongga" will certainly be a source of confusion. On the other hand, its true native name, Vesogogoto, can hardly be recommended. The best way out of the difficulty, in my opinion, would be to give the island a name altogether new. If this measure be adopted, I should like to suggest that the name chosen should be Woodford island. An outlying island of New Georgia has already been called after Mr. Woodford, but the bestowal of his name on this large and important island would give a more suitable memorial of his administration of this region since it was first brought under British influence.

For the reasons I have already considered, the term Vella Lavella is so free from sources of misunderstanding, and is now so well established, that I have no hesitation in continuing to use it. For the other large islands of the group I propose to use Choiseul, Ysabel, Florida, and San Cristoval, which are not only free from sources of misunderstanding, but have the greatest historical interest.

In the Torres and Banks groups most of the islands are small, while the native names ordinarily used for them are almost certainly correct names for the whole islands, and therefore I propose in general to use them, viz. Mota, Merlav, and Ureparapara, rather than the names of European origin. For the larger islands I prefer to use either the terms, Santa Maria and Saddle island of European origin or the unambiguous native term Vanua Lava.

In the present state of our knowledge of the New Hebrides the only safe plan is to use Pentecost, Aurora, and Lepers' islands in place of the doubtful native terms, Raga, Maewo, and Omba.

I should like to take this opportunity to raise one or two other problems in the geographical nomenclature of this part of Melanesia.

The term "New Hebrides" is used in two senses, sometimes including the Banks and Torres groups and sometimes excluding them. I hope the latter usage may become fixed. Ethnographically, the Torres and Banks islands have each definite characters which separate them from each other and from the islands south-east of them, and this difference of ethnographic character fully justifies the separate nomenclature, which was doubtless due originally to their geographical separation from the main group of islands.

Again, there has been much variation in the names used for the group of islands lying between the Torres and Solomon islands. The small islands to the north of Santa Cruz island have hitherto been known as the Swallow and Duff groups, but locally they are all known as the Reef islands, and this usage has been creeping into ethnographical literature. It seems to me well justified, and in the map I have therefore omitted the older terms and have called the whole group of small islands the Reef islands. Another doubtful point of nomenclature is what should be the full application of the term "Santa Cruz islands" as opposed to Santa Cruz island. Should it include only the island of Santa Cruz (nDeni), Utupua, and Vanikolo, or should it also include the Reef islands? I am on the whole in favour of the latter alternative.

Another point which I should like to raise is whether Bougainville island might not be excluded from the Solomon islands and included in the Bismarck archipelago. Not only is the island now politically part of this archipelago and separated from the rest of the Solomons, but ethnographically it appears to resemble other parts of the Bismarck archipelago more closely than the islands with which it is now grouped.

In conclusion, I wish to urge that the problems I have raised in this paper are not such as should be settled or whose settlement should be attempted by any individual. This is clearly the duty of some public body, and it is in the hope that this task may be undertaken by the Royal Geographical Society that

I have brought the matter before this Research Meeting. I should like to suggest that this Society should have a standing committee to deal with such problems. The nature of nomenclature of places is a subject on which the ethnologist must evidently have much to say, and it is a question for consideration whether their aid could be best obtained by constituting a committee jointly with the Royal Anthropological Institute, or whether the case would be met by the presence of ethnographers on the committee.

In this paper I have purposely dealt with the problem as it concerns the anthropologist, and have neglected certain considerations which would have to be taken into account by such a committee as I propose. It is evident that the names of places are of such practical and especially commercial importance that the matter cannot be settled purely, or perhaps even chiefly, on lines suggested by purely scientific considerations.

Let me again take the island I have proposed to call Eddystone as an example. This island is now generally known in the Solomon islands as Simbo, and since it is now visited several times a year by English or German steamers, this name is gradually passing into general commercial use. There are thus at work economic forces which are tending to perpetuate the name which the island has obtained locally. If no special action be taken, these economic forces will be much stronger in the long run than any purely scientific considerations, and it may even be argued with much show of reason that these forces are so powerful that it would be useless to attempt to stay their action. There are, however, several features of the situation which make it probable that a body such as the Royal Geographical Society could do much to direct the line which development will take. Not only would such a committee have much power in the settlement of the names to be used on charts and atlases, but much could be done by gaining the co-operation of officials and missionaries. The advantage arising from the co-operation of officials will be clear to all, but that to be expected from the aid of missionaries is perhaps not so obvious. Since, however, missionaries are usually the first Europeans to settle in a place, and since they often educate the natives with whom officials and traders come later into contact, their help would be of the greatest service, and I have no doubt that the various missionary bodies at work in Melanesia would be only too glad to assist such a committee as I propose, and the combined influence of officials and missionaries would, I believe, go a long way towards directing the economic forces into reasonable channels.

I have in this paper only dealt incidentally with the spelling of native names used to denote places, but we have here another source of confusion which will become more and more serious as time goes on. It would require a paper as long as that I have already given if I were to attempt to go into this matter fully. All that I need point out here is that such a committee as I propose could also deal with the problems arising from the several different systems of spelling native words at present used in different parts of Melanesia.

Sir Everard im Thurn: I have listened with the very greatest interest and sympathy to Dr. Rivers, but I think he has hardly calculated on the difficulty. If he simply means that a committee should organize a system of names to be used by scientific anthropologists, well and good; but I very much doubt whether any such system, devised by the most authoritative committee, would receive general acceptance. I think I am right in saying that a good many years ago there was a committee on which the Geographical Society, and the Hydrographical Department of the Admiralty, and I think the Colonial

Office were represented, which laid down a system of spelling of names; and there is an official circular on this spelling of names; but I know by my own experience that it is seldom used! I do not mean that in a map published by the Geographical Society that spelling would not be used; but in ordinary official ways it is not used, and certainly the ordinary person living in the islands would not use it. When strangers go among the islands—for instance, when Dr. Rivers went there, a high scientific authority—he found that the names were vague and of vague application; he made his inquiries and he got answers as to the various names of places; and he made up his mind to some extent what ought to be done to correct the confusion; but I do not think he would find the people there, the officials and the traders, would agree with him, or rather would use his names. The names are so constantly changing that it is really impossible to fix upon one. It seems to me almost impossible for any committee to work out here, on this side, a list which would be generally accepted. I am afraid I have rather suggested that in my opinion it is hopeless to do anything; and I am sorry to have done so, because I strongly sympathize with the wishes of Dr. Rivers on the subject, and I shall be very glad to find that he is right and that I am wrong.

Mr. B. Glanvill Corney: I have listened with very great interest to Dr. Rivers's paper; but I confess I feel that the subject bristles with difficulties, and that the proposal by which it is meant to attack it will involve the exercise of arbitrary control over that which has come about in reality by natural evolution—and would, therefore, seem like treading on dangerous ground. In that sense I am afraid it does not promise quite the success we should all wish for it. One of the suggestions in the paper was that something should be done to bring about a uniform system of spelling for native names. That, too, I am afraid is a somewhat hopeless task; but would it not perhaps be better to set about that first, before we name or re-name any islands, so that the uniform spelling arrived at could be applied to the names decided upon? There are some islands in the South Pacific which have no native names, so far as we know—chiefly because of their large size and split-up population and dialects; there are others whose native names we have never known, because when first discovered by Europeans they were unpeopled, or because their native race has since died out. Such an island is Swain's, or Gente Hermosa. The Solomons are admittedly difficult to deal with because of their many dialects; the New Hebrides almost as much so. Then there are a few islands, one of which has been mentioned to-night, which come in a different category; for Tikopia is not the only island of that name. I can recall two others, with only dialectic differences in pronunciation. Anuda or Yanutha is another of this class; for I know one in the New Hebrides, another east of the Santa Cruz group, and a third in Fiji. And there are three others named Uea or Uvea. Such names should be retained.

Something with which I cannot quite agree was said about one or two islands in the New Hebrides, more especially the group of adjacent ones known as Lepers' island or Oba, Aragh or "Pentecost," and Maiwo or "Aurora." Those islands have, within my experience, native names. Lepers' island has been maligned by the name Bougainville bestowed upon it, from the date of its discovery. I do not think its natives should have that stigma cast upon them; for they are the fairest, cleanest-skinned, and the most domesticated of all the natives of the New Hebrides. I should be very glad to see the matter permanently unravelled from its present tangle; but I confess my sympathy is rather with Sir Everard im Thurn's view that to secure general acceptance will prove an almost hopeless task.

Dr. A. C. Haddon: It seems to me that the last part of Sir Everard im Thurn's speech proves the need for some action to be taken, since he admits the island nomenclature to be in a confused condition, and the last speaker practically concurred. But he places us in this predicament. He admits ambiguity, and then leaves it to natural selection to find the right name for an island. We are asked, in fact, to wait until the ordinary traders have arrived at some sort of unanimity among themselves as to what the islands should be called, and then to follow their lead. It seems to me that something should be done on the lines of Dr. Rivers's suggestion; it is quite obvious no recommendation can be binding, but if geographers at home adopt a rational name for each island, it is probable that in a large number of cases officials and missionaries would adopt it, and then the traders would have to follow suit. Something should be done also to secure uniformity in the spelling of all the place-names. Everybody admits there is a muddle in nomenclature, and it seems to me the obvious thing is to try and clear it, for the difficulty of a task is not a sufficient reason for abandoning it.

Mr. Sidney Ray: I think we owe some gratitude to Dr. Rivers for bringing forward this subject. It is most interesting and very important, and yet I think there are ways out of the difficulty. Dr. Rivers called attention to several of the difficulties which have arisen, but did not give any specific examples. He mentioned one island, of which a totally wrong impression as to the character of its people has been given, through the wrong use of its name Uvea. This western island of the Loyalties has got the same name as a place further to the north-east, Wallis island, almost in the middle of Polynesia. Wallis island is inhabited by Polynesian people, and a little corner of Uvea, in the Loyalties, is also inhabited by Polynesians, but the majority of the population is Melanesian, and speaks a language which is different, so far as Melanesian languages are different, from Polynesian, and a language not even like that of the neighbouring islands of the Loyalties. But in most geographical books you find it stated that the people in this island are Polynesians, who came from Wallis island, when, as a matter of fact, there is only a small colony of Polynesian people in the island. Then with regard to the retaining of the names, I think the problem is already settled so far as the larger islands are concerned, that is, those islands with European names. It seems that the main thing to be done is to determine as to the provision of a European name for islands which are at present known by a supposed native name. If the island is a small one, with only one or two villages, where the people are closely related to one another, and speak the same language, it is probable that a native name can be found for that island, but in the case of a large island, I doubt if it is at all possible to find one name which is really a native name. In the New Hebrides, for instance, the name of the island Malekula, is probably a wrong use of a native word which does not apply to any particular place. As far as I know, the word itself simply means "a place where coconuts grow." Then an island like Ambrym is known by various names in books—I think in the British Museum there is a book from there in the language of Fanting, which means "in the language of men"—and the name Ambrym is supposed to have been taken from the native word "fire" because of a volcano existing on it. In cases where the name has become stereotyped by long use, and is of a very general signification, like Ambrym, it does not matter what it means. An island like Malekula can be called Malekula without any reference to the meaning of the name because it would mean any village, any place, or any island. But in the case of a place like Ganongga, I think the object of geographers should be to fix for that place a European name. In giving

accounts, it would be necessary always in any scientific treatise to give the exact locality in which the information was gathered. I expect in deciding names the chief difficulty would arise through the fact that they are probably given by the officers who survey the islands for the first time. They send the name home on their draft map and it becomes printed on the chart, as the name of the place, without any reference to people at home. With regard to the spelling of the native names, I do not think that any difficulty ought to arise. The missionary prints a book for the use of the natives. It does not matter in what alphabet so far as outsiders are concerned. The natives learn the alphabet which relates to their book. If people at home spell the names in another way, there is no necessity to spell that way for the natives. As a matter of fact, in most of the islands they would spell that word "Ganongga," in the alphabet as used for the natives with an italic *g* for *ngg*. That is, one letter for one sound. While that way of spelling would probably not be used in England, it presents no difficulty. The person at home can spell it as it is spelled on the chart at home, and the missionary can spell it in his phonetic alphabet.

Mr. DREW: I agree with Dr. Rivers in thinking it would be a very good thing if there were some rule made as to the nomenclature of the islands. There is one point he did not mention, that is the spelling of the name of the Solomon islands themselves. I do not know how the Spaniards spelt Solomon, but in almost all atlases it is spelt Salomon. I should think the English spelling in this case would be the best. I should prefer to keep the Spaniards' spelling in the case of San Cristoval, namely, without an "h" after the "C"; but in the Solomons I do not think it would be the best, for the English spelling has already been in use on the stamps of the Protectorate for some years. I think if a committee were to settle on some rule or other, it would be the means of deciding how the names should be printed, at all events in charts and atlases, and so they would possibly get into common use.

Prof. MYRES: I think it will be the wish of the Committee to express its thanks to Dr. Rivers for his paper and for the discussion which it has provoked. There is, I think, some reason to hope that tangles of this sort will settle themselves if we give them time; and so far I think we may fairly sympathize with those who suggest that natural selection should be allowed to do this difficult work. As a student of ancient geography, I have had occasion quite recently to go into matters of early nomenclature in regard to the Greek Archipelago. There, as is well known, the islands in particular (I do not know whether it is one of the weaknesses of islands) have suffered from plurality of names; yet by the time that Greek history begins, all but one or two of them had shed their duplicates and retained a standard name which was commonly accepted; and the process by which the original confusion was created, and also that by which it was definitely resolved, certainly suggest many points in common with the processes which we are observing at the present day.

Dr. Rivers's paper dealt, of course, primarily with the actual nomenclature, but it has provoked discussion not only on this, but also on a closely kindred (though really separate) topic, that of the spelling of the names when you have got them. In regard to the second point (to take that first), it is perhaps worth while to remind the Committee that the Society has interested itself greatly in this matter, and I think may fairly take credit to itself for having gone some way towards introducing an orderly orthography. As long ago as 1878, the Society took its first move, and the system of orthography adopted by the Council at that time has persisted with very slight alteration. As early as 1885 it was adopted, in principle, by the Admiralty and the War Office, and it

has also been accepted in principle by the Foreign and Colonial Offices. Perhaps even more important than that, a system which only differs in small details has been adopted by the Government of the United States for its surveys, and that Government has carried into practice the very suggestion which Dr. Rivers made, of having a consultative committee, to which new names should be referred before being finally adopted. The French system, too, in its general outline, agrees closely with that which was proposed, and has been used, by the Royal Geographical Society. So much for the question of spelling. On the question of nomenclature, the Society has also put out, in its Year-Book, on p. 56 of the current edition, some hints which I think travellers, and perhaps also administrators, would do well to observe—which, indeed, many of them do observe—on the giving of names to newly discovered places.

At the same time, Dr. Rivers's paper has put the matter before us in the light of new concrete instances, and I think this meeting ought not to adjourn without recommending, as I propose we now should do, to the Council of the Society, "That the question of nomenclature arising out of Dr. Rivers's paper be referred for consideration to the Council of the Royal Geographical Society with a view to systematic and concerted action."

Dr. RIVERS: I am very glad to second Prof. Myres' proposal that the matter shall be referred to the Council of the Society. In reply to Sir Everard im Thurn and Dr. Corney, I should like to say that I hoped to have made clear in the final paragraphs of my paper how fully I recognize the difficulties which will confront any attempts to influence geographical nomenclature. The conditions in Melanesia, however, are moving in so unfortunate a direction that there seems to be a clear case for departure from a *laisser faire* policy. I should like again to express my conviction that this Society alone can do little or nothing; it is only by the cordial co-operation of officials and missionaries, and possibly even of trading companies, that there can be any hope of success.

I am afraid that I cannot share Mr. Ray's optimistic view that the names of the larger islands are already finally settled. Unless something is done it seems to me almost certain that even such a name as Ysabel with all its historical associations will disappear, to be replaced by some corrupted form of a native name which is not even properly the name of the whole island, but only of one of its districts. It is because the tendency of local conditions is to change even long established geographical nomenclature that interference seems so necessary. In spite of the difficulties I believe that it is possible, at any rate in some cases, so to influence these local conditions as to lead to the establishment of a nomenclature which shall combine scientific accuracy with the preservation of historical associations.

THE PROJECTION FOR THE INTERNATIONAL MAP OF THE WORLD.

THE *Comptes Rendus des Séances de l'Académie des Sciences*, t. **153**, p. 559 (Séance de 18 Septembre 1911), contains a paper by M. Ch. Lallemand, in which he gives an investigation of the projection decided upon for the construction of the International Map of the World on the scale of 1:1,000,000, with special reference to the limits of error for a single sheet of the map. M. Lallemand, who is the Inspector-General of Mines and Director of the Survey of France, was one of the

delegates of the French Government at the committee which met in London in 1909, and has throughout taken a great interest in this project.

The resolutions of the International Map committee were published, and afterwards reproduced in the *Geographical Journal* for August, 1910. From these it will be seen that it was considered necessary that the projection to be adopted should fulfil the two essential conditions—(*a*) that the meridians be straight lines, and (*b*) that the parallels be arcs of circles of which the centres lie on the prolongation of the central meridian.

On the scale of the map (1 : 1,000,000) several suitable projections differ but little from each other, and as contraction and expansion of the paper on which the map is printed is certain to prevent its being strictly either orthomorphic or equivalent, it was finally decided that a modified polyconic projection would be most suitable, as it could be made to fulfil the required conditions with sufficient accuracy, and has the further advantage of being simple in construction. Each sheet, which is to include 4 degrees of latitude and 6 degrees of longitude, will be separately constructed on its own central meridian; and for a better distribution of the errors, the meridians which are true to scale will be those which are 2 degrees to the east and west of the central meridian instead of that meridian itself, which will therefore be slightly shorter than its true length.

Under these conditions M. Lallemand has undertaken the investigation of this projection, and in the paper referred to, gives formulæ for the construction of the sheets, and the maximum amount of their linear and angular errors. In his mathematical investigation he has not considered it necessary to go to extreme theoretical accuracy in some respects, and has only attempted to arrive at results sufficiently accurate for the purpose. Those interested in the subject will do well to refer to this paper, but it may be useful here to give the final results as regards the errors, which are as follows: The length of an arc of the meridian will in no case be in error more than $\frac{1}{1270}$ of its true value, which corresponds to a maximum uncertainty of 0·35 mm. (0·0138 in.) in the height (0·44 metre or 1·44 feet) of a sheet; whilst, upon a parallel, the relative error will never exceed $\frac{1}{3200}$, being 0·2 mm. (0·0078 inch) upon the greatest breadth (0·67 metre or 2·2 feet) of a sheet. As regards error in azimuth, M. Lallemand finds that in no case can this amount to more than 6 minutes of arc. In concluding his paper, he points out that these errors, linear or angular, are much smaller than those which will be occasioned through hygrometric deformations in the paper upon which the map is printed, and are not likely to create difficulties in the joining up of adjacent sheets. They may, in fact, be considered as practically negligible.

It may be mentioned that the Official Resolutions and Proceedings of the International Map Committee, published in 1910, contain tables for the construction of the sheets of the map for all latitudes, and that a revised edition of these tables has recently been issued.

REVIEWS.

EUROPE.

A Study in Coast Geography.

'The Coast Scenery of North Devon.' By E. A. Newell Arber, M.A. London: Dent and Sons. 1911. 10*s.* 6*d. net.*

In this profusely illustrated volume Mr. Arber points out in a wholly admirable fashion a new and hitherto undeveloped field of work for the scientific geographer. It is somewhat disappointing, however, to find that the author does

not recognize the importance of his work from the geographical point of view. He makes no call on the attention of geographers, although it is they who will be his most numerous readers. On the contrary, he appeals to geologists to overlook the elementary nature of much of the information which he gives, and at the same time invites them to undertake with him an investigation into the origin of the coast scenery of North Devon, for which admittedly little geological knowledge is required. For a geological guide, indeed, the details are too scanty, and even in places misleading; as when the author says that, "geologically speaking, the greater portion of Devonshire and Cornwall is really a vast coalfield."[2] On the other hand, the geological details are sufficiently brief and free from technicality to render the book one of absorbing interest to geographers. The limits of the respective provinces of geology and geography are even yet in certain quarters little understood. Both studies can frequently be carried out with advantage simultaneously, but a sufficient discrimination should be made in the end between the results which belong to the one or to the other of the two sister sciences.

Mr. Arber, in his detailed account of the coast scenery, makes very clear to us the rugged and precipitous character of much of the coast-line, the skill and agility required for the gentle art of "beach-crawling," and the unhappy results in places of the "civilization" of the shore. The addition of a certain amount of more purely artistic description would have lightened this part of the book, and relieved its occasional tediousness to the general reader who is unacquainted with this particular locality. As it is, one turns with more avidity than necessary to the latter part of the book, in which the author's general conclusions are set forth. There can be little doubt that in his hypothesis of the sea erosion of a former stretch of land, the author has found the true explanation of many puzzling features of the coast scenery. In his opinion this former land possessed a well-developed hydrographic system of its own, and stretched seawards for a distance of at least 12 miles from the present coast-line. He omits, however, to give a chart of the neighbouring sea-floor, which would undoubtedly have afforded some interesting evidence on the one side or on the other, while he suggests no reason for the breach of the coastal watershed by the estuary of the Torridge and the Taw. The contrast between Hog's-back and Flat-topped cliffs is sufficiently emphasized and clearly described; but while one may agree that the former are in some way due to aerial erosion, one regrets that the author has not seen fit to enter into a fuller discussion of the origin of these peculiar rounded ridges and slopes in their relation to the earlier drainage system. The author, moreover, while admitting that heavy pebbles may be carried rapidly along the coast by the tides and currents, apparently rejects the similar transport of sand, and expresses the opinion that sand arises from the attrition of boulders *in situ*, and always represents a late stage in the evolution of a beach. Fuller discussion of these points would have been profitable, as also a more detailed explanation of the author's suggestion that when the prevailing winds and current strike the coast-line obliquely, intense scouring occurs on the leeward side of prominent headlands. An interesting and convincing demonstration is given of the relative stability of anticlinal structures and instability of synclinal structures when exposed to marine erosion, and the detailed sculpture of folded rocks by the sea is admirably discussed. Although, as the author himself admits, his conclusions may not all be readily accepted, his work is distinguished by its suggestiveness, its living interest, and its wealth of illustration. There are many portions of our coast-line which lend themselves to similar treatment, and nowhere would similar study be entirely

unprofitable. We hope that Mr. Arber will continue his researches in this "strange land" which he has discovered, and that followers in his footsteps will not be few.

J. D. F.

Wiltshire Maps.

'A Descriptive Catalogue of the Printed Maps of Wiltshire, from 1576 to the publication of the 25-inch Ordnance Survey, 1885.' By Mr. Thomas Chubb, of the Map Room, British Museum. (*Wiltshire Archæological and Natural History Magazine*, vol. 37, p. 211.) 16 pp. Devizes. 1911.

This is a valuable contribution to the special subject of British county maps, which forms a section of the limited but slowly growing literature of engraved cartography. It is founded on the first attempt at a complete study of the maps of an individual county—the 'Hertfordshire Maps' of Sir H. G. Fordham, completed in 1907.

In a brief introduction the author refers to some of the earlier maps of a local character, and sketches out the frame of the Catalogue which follows, embracing the printed maps of Wiltshire from that of Christopher Saxton, dated 1576, to 1885, the date of publication of the 25-inch Ordnance Survey maps, with which the need of any special local or county maps finally disappears. The arrangement is in order of date of impression of the maps themselves, which sometimes precedes that of the atlases or other topographical works in which they appear. This is, perhaps, the most convenient course to adopt, though it has the disadvantage of placing some maps under a date which is not of so general application, or so easily traced as that of the atlas to which they belong. Thus Saxton's map is dated 1576, but one would look naturally for it under 1579, the date of the atlas in which it is found. On the other hand, the author adopts the *atlas-date* (1617) for Peter Keer's small map in Regnerus Vitellius's 'Epitome of Camden's Britannia,' whereas the map is one of a set engraved after Saxton, some of which are dated 1599, which may be safely taken to be the *map-date* of the whole set. The use of a variety of type has added greatly to the facility with which the date, title, and descriptive text, or biographical notes can be picked out. Some of the biographical references are especially valuable, and add to the general interest of the compilation. The Catalogue itself seems very complete. One or two omissions, *e.g.* those of the maps of Wiltshire in 'Bowles' Pocket Atlas of the Counties of South Britain or England and Wales,' issued about 1785, and in 'Langley's New County Atlas of England and Wales' (1818), may be noticed. The author does not seem to connect with the playing-card series of small county maps, issued by Robert Morden about 1680, that made use of in Turpin's 'Brief Description,' attributed to 1750. These dates are very wide apart, but it seems, on inspection, that the impressions in the two atlases are identical. A similar use of old plates is that of the county maps engraved by John Seller, and published in the *Anglia Contracta* of 1695, which reappeared in Francis Grose's 'Antiquities of England and Wales, 1776.' Recent investigations have disclosed a larger number of issues of each of the three series of John Cary's atlases ('New English Atlas,' folio; 'New and Correct Atlas,' quarto; and 'Traveller's Companion,' octavo) than are catalogued by the author. The notes on Cary's publications are also insufficient, and give no idea of the quantity or value of his work. Subject to these trifling defects, for which the difficulty incidental to the subject is an ample justification, nothing but good can be said of this publication, and of the care and industry of its compiler. The tabular index, arranged under the names of authors, engravers,

and publishers, giving the date, title, and dimensions of each map, and the title of the work (if any) in which it appears, is a valuable feature of the catalogue.

ASIA.

Central Asia.

'The Ruins of Desert Cathay.' By M. Aurel Stein. London: Macmillan. 1912. 42*s.* net.

This work is another monument to Dr. Stein's indefatigable industry, his untiring persistence, his never-wavering courage, and his inexhaustible optimism and patience. It is a wonderful record. The only regret is that the good things there are in this book are so difficult to excavate. The record is of an expedition whose object was the discovery of hidden treasures. To obtain those treasures Dr. Stein had to have at his disposal ample time, and to be possessed of dogged persistency of purpose. And these same things are no less required by the reader who would seek the valuable things in Dr. Stein's book. He must have plenty of leisure and must steadily persevere, and his efforts will then reap a rich reward. He will imbibe something of Dr. Stein's own enthusiasm. He will plod on through masses of minutiæ in the cheerful hope of being rewarded in the end. He will be undaunted by interminable delays in reaching his objective. But when at length his goal is reached he will find a rich reward.

For it is of fascinating interest to read of, and to have presented before us, excellent pictures of objects which have lain hidden beneath the sands of the remotest desert in the world for fifteen or sixteen centuries. It is even more interesting to know that these objects, manuscripts, images of Buddha, coins, domestic utensils, frescoes, rolls of silk, etc., testify to the existence of a civilization which was a curious blending of the civilizations of China, India, and the classical West.

With the experience of his previous journeys to guide him, Dr. Stein from the very first made valuable archæological discoveries. At Niya he found the remains of an office with records intact dating back to the third century A.D. Here were accounts, lists, official files, and archives of rectangular documents—probably bonds and agreements—with double seals intact, and envelopes still unopened. The seals were of classical workmanship representing Heracles, Zeus, and helmeted busts. While the documents showed that the administration was carried on in an Indian language and script, and that immigration must have occurred from North-West India. Sheaves of corn in perfect preservation, household objects, and wooden implements were also found in the same ruins. And as we read the record of the "find" we understand Dr. Stein's enthusiasm and his zest to make still further discoveries among these long-buried cities.

Perhaps his most fascinating quest was the ruins at Lop-Nor. These had previously been discovered by Dr. Sven Hedin, but Dr. Stein approached them from a different direction and had to pick them out in a waterless desert a week's journey from his base. On the accuracy of Sven Hedin's position for these ruins all depended. Stein, giving his camels a good drink of water to last them several weeks, and taking with him blocks of ice, plunged into the sandy ocean. "The overpowering vastness which the desolation of the lifeless Lop desert produced" was relieved only by the occasional sight of the great ranges of the Tian Shan on the north and the Kun Lun on the south. He set up prominent marks for his men to find their way back by, and established a depôt of thirty pony-

loads of ice. Carefully making his way by survey, he at length caught sight of the ancient city, and found that his own observations only differed from Hedin's by 1½ miles in longitude and ½-mile in latitude—a real triumph of geographical science.

Here he found records in the ancient Indian script, Kharoshti, even so far east, also fragments of a well-woven pile carpet with well-preserved colours, a bale of yellow silk, spoons, eating sticks, fragments of dishes in bronze or lacquered ware, small objects in metal, glass, and stone, and Chinese records on wood. And among the ruins was a Buddhist shrine with excellent wood-carving of unmistakable Græco-Buddhist design. From all he found here Dr. Stein surmised the ruins were of a small fortified station garrisoned by Chinese troops in the third century A.D., and his discoveries showed that this forgotten dead corner of Central Asia had once been linked by relations of art, trade, and culture with all the great civilizations of the ancient world.

But the most sensational discovery was that of a great hoard of Chinese manuscripts in a hidden chapel carved in the rock at Tun-huang. Heaped up in layers was a solid mass of manuscript bundles rising to a height of nearly 10 feet and occupying a space of close on 500 cubic feet. Chinese records show that the sealing up of this chapel must have taken place early in the eleventh century. From the time of William the Conqueror to the present day the contents had never been touched. They included manuscripts, and even printed scrolls, and paintings on fine gauze-like silk. The bulk of the manuscripts went back to the time when Indian writing and some knowledge of Sanskrit still prevailed in Central Asian Buddhism. They were in Sanskrit and in one or other of the "unknown" languages used by Turkistan Buddhism. Among these the most valuable was a well-preserved Sanskrit manuscript on palm-leaves in small but beautifully clear handwriting, dating back to the third or fourth century A.D. at latest. It was the manuscript of a work well-known in the Northern Buddhist Canon, and the material used indicated that it must have been written in India itself. These manuscripts were tangible proof that the monastic communities established at Tun-huang in a population mainly Chinese maintained direct connection with their co-religionists in the Tarim basin, from which Buddhism first reached China. They showed also the large part played by Buddhist propaganda in linking civilization right across Asia. Tun-huang was also connected with Tibet on the south, and the Chinese records showed that it had been conquered by the Tibetans about 850 A.D.

Of particular interest was a roll with its text *printed* and showing a date of production corresponding to 860 A.D., and thus furnishing evidence that the art of printing from woo en blocks already in the ninth century had attained as high a technical level as the process permitted.

The majority of the pictures nd frescoes on the walls belonged to the T'ang period (seventh to ninth century) A.D. Many of them were of real grace and beauty and represented scenes in the life of Buddha, treated in the Chinese fashion, much as scenes in the life of Christ were treated in the Italian fashion by mediæval painters.

The object of the expedition was mainly antiquarian, but it also produced valuable geographical results. By his observations and his photographs, Dr. Stein has added to our knowledge of that phenomenon which was one of the chief factors in the depopulation of this regio.—the general desiccation of Central Asia. He does not admit that this was the only cause. There were political considerations too, such as the decay of central Chinese authority

which caused the abandonment of over-thriving cities. But the gradual drying up of the climate and the consequent shrinkage of the water supply was undoubtedly the chief cause. Another valuable result was his observation on the tremendous erosive force of wind-driven sand. This is a geological agency which greatly affects the geography of these wind-swept regions, denuding surfaces as effectively as the rain with which we are more familiar.

The detailed survey carried on by surveyors Ram Singh and Lal Singh under Dr. Stein's supervision have been worked out on a scale of 4 miles to the inch in an atlas of ninety-four map sheets. The most important geographical discoveries were made in the Kun-lun mountains south of Khotan, where a systematic triangulation of the region round the upper waters of the Kara-kash river was made; and in the Nan-shan ranges where some 20,000 square miles were mapped in a region very imperfectly known. Here, as in his main archæological work, Dr. Stein showed the same indomitable courage, foresight, in preparation and zest in execution.

F. E. Y.

'The Trade of the East India Company.' By F. P. Robinson. (Cambridge University Press. 1912. Pp. vii., 186. 3*s.* 6*d.*) This prize essay not only covers the history of the East India Company from 1709–1813, but also gives a very clear picture of Indian life during that period. The point is strongly made that India was not and never can be a colony in the sense of the settlement of a large number of English people there for life, owing to its climatic conditions. The trade-routes and trading conditions in the East may be well studied in this very careful work, to which a full list of authorities is added.

'The China Year-book.' By H. T. Montague Bell and H. G. W. Woodhead. (London: Routledge. 1912. Pp. xxxvi., 463. 10*s.*) This is the first issue of what should prove a most useful and valuable year-book. It enters very briefly into the physical, geographical, and geological aspects of the country, with a view, no doubt, of not trenching upon the ground of standard works. The climate, however, is more fully dealt with, and figures are furnished. The trade and administration and government are considered in ample detail, and a mass of statistics are included, such as are not easily come by. The revolution in China is the subject of a careful inquiry.

AFRICA.

The Central Sudan.

'Republique Française: Ministère des Colonies.' Documents scientifiques de la Mission Tilho (1906–1909). Tome Premier. Paris: Imprimerie Nationale. 1910. The same, Tome Deuxième, 1911. Maps (in separate portfolio) 1, 2, 3, 1910; 4, 5, 6 et 7, 1911.

Few scientific missions engaged on geographical problems have been more thoroughly equipped than that which was sent under Captain Tilho to the Central Sudan. In addition to the delimitation, in conjunction with a mission under Major R. P. O'Shee, of the Franco-British frontier between the Niger and Lake Chad, Captain Tilho and his colleagues were charged to make a particular study of the geographical features of the Chad region. Many other studies of a scientific character were also to be made—one might say that Captain Tilho was instructed to take all knowledge (of the Chad countries) as his province. The mission, which spent over two years in Central Africa, obtained very valuable

results. Its records, after three years' "working out" at home, are now available in the volumes under notice, printed at the expense of the State. They do not complete the labours of the mission. Dr. Gaillard's account of his investigations in ethnography, of the flora and fauna of Lake Chad, and in other branches of natural history, has still to be published. We note also a mention in vol. 1 of a Hausa grammar and a Hausa-French dictionary (both by M. Landeroin) as to appear in vol. 2, in which, however, they are not included. While regretting this delay, the other members of the mission sum up the general results obtained. Many of the records are of a highly technical character. They have won the warm commendation of Colonel R. Bourgeois, chief of the geodesy section of the Service Géographique of the French Army.

The work accomplished, and herein set out in full detail, included the compilation of a map of Lake Chad and the region extending east as far as Borku; studies of the variations in the levels of the Chad, of its altitude and that of the neighbouring depressions, of the meteorology and climatology of the region, and of the history and ethnology of the lands lying between the Chad and the Niger. A large number of geographical positions have been determined with precision. So careful was Captain Tilho in making his calculations that to maintain his chronometers always in the same condition he had them carried a fixed distance every day when his camp was stationary. Colonel Bourgeois declares that the exposition of the work done and of the methods utilized constitute a treatise which may rank as a classic in all that concerns the astronomical determination of geographical positions in exploration.

That part of his investigation which provoked Captain Tilho's liveliest interest concerned the Chad hydrographical system. It has been long disputed whether the Bahr-el-Ghazal (of the Chad system) is an affluent or an effluent of the lake. The mission, after careful measurements of altitudes, is able to state definitely that it is neither, but that for the part between the lake and Fantrassu the Bahr-el-Ghazal is simply a prolongation of the Chad itself. Lieut. Ferrandi, who has followed the "stream" from Fantrassu to Jerab, reports a continuous downward slope. The whole question of the levels of the country east of Chad is full of interest, and the Tilho Mission results involve a considerable remodelling of the map. The land falls from the Chad to Borku: that is now determined. Whether from Borku it continues to fall towards the Nile basin has not been ascertained. So that we have not yet arrived at a solution of the problem of the mythical river which, according to old maps, united the Chad and the Nile.

A great part—perhaps a half—of these handsome and lavishly illustrated volumes, while strictly scientific, is non-technical. The historical chapters and the ethnographical information are attractive sections. The history section, by M. Landeroin, is most carefully compiled, and gives some fresh views of the peoples of the Central Sudan, whose civilization the writer rather belittles—or so it seems. There has been no attempt, however, since Barth wrote, to deal so thoroughly with the subject. Separate chapters are given on the history of exploration, in vol. 1, pp. 2–22, on the explorers of the lake—a model of condensation and lucidity; and in vol. 2, pp. 3–9, on the explorers of the aptly named "Pays-Bas" of the Chad.

There is such a mass of material in these volumes that (despite a full table of contents) in the absence of an index the reader may be at a loss to find the particular information of which he is in search. However, he will find set forth in vol. 2, pp. 601–613, the general conclusions as to facts established by the mission. This is a fascinating and suggestive chapter, and should stimulate

exploration of the southern part of the Libyan desert. It closes the record, and its last words are in praise of the good work for the Central African races achieved in concord by France and Great Britain.

The book has many authors, some named, some anonymous. It has yet a thorough unity, due to very efficient editing, though by whom this has been done is nowhere indicated. F. R. C.

'Tripolitania e Cirenaica dal Mediterraneo al Sahara.' By A. Ghisleri. (Milano, etc.: Società Editoriale Italiana. 1912.) A well-written compilation on the countries that now figure so conspicuously in Continental politics. The author has been at much pains to examine with thoroughness the numerous sources of information dating from classical periods down to the recent exploration of modern travellers. The history, geography, and topography, communications, and inhabitants are exhaustively dealt with, and a profusion of good photographs illustrating the oases and more interesting parts of the coast, the wadys, and the hinterland, combine to show that the capabilities and resources of northern Africa are greater than is popularly imagined. Representations, too, of the buildings and antiquities of the Roman period are a proof that in those days the population must have been considerably larger, and yet have found means of sustenance. All this, no doubt, has encouraged the Italian nation in the hope of resuscitating the ancient glories of their future possession.

'About Algeria.' By C. Thomas-Stanford. (London: Lane. 1912. Pp. 306. *Map and Illustrations.* 5*s.*) This author deals with travels over a considerable part of Algeria which did not take him away from beaten tracks; indeed, it will be gathered they were for the most part carried out by motor-car. The volume is made the repository of a number of beautiful drawings of old doorways (by Mr. Thoroton), besides a number of photographs. The centres chiefly described are Algiers, Tlemçen, Constantine, Biskra and Timgad.

'Natal: Descriptive Guide and Official Handbook.' Published by authority. (Durban: South African Railways' Printing Works. 1911. Pp. xi., 574. *Maps and Illustrations.* 7*s.* 6*d.*) This appears to be an excellent example of the official colonial handbook. It contains special articles on the early history, the natives, the mammals and birds of the territory, and also on its mining, agriculture, fruit-farming, and other economic subjects. Its copious illustrations are accompanied by descriptive text, and a large proportion of them are taken along the lines of the various railways. The plans and maps are somewhat rough, but there is an ingenious and instructive perspective plan of Ladysmith at the time of the war. The index might well have been extended for the purpose of easier reference.

AMERICA.

'Alpina Americana.' No. 2. Published by the American Alpine Club, Philadelphia. 1911. *Illustrations and Maps.*

This is the second publication of the American Alpine Club, and is a monograph on the Canadian Rocky mountains, by Prof. Charles E. Fay. The number is splendidly illustrated with a series of photographs of all the more important summits of the Canadian Rockies—Mounts Assiniboine, Lefroy, Columbia, Robson, etc. The illustrations, also, of Lakes Louise, O'Hara, and the waterfalls in the Yoho valley are most beautiful. At the end is an interesting list of peaks above 10,000 feet, with positions, altitude, and data regarding first ascents, together with a reproduction of Palliser's map of the Rocky mountains from the boundary line north to the Athabasca, and another map of the main

range of the Canadian Rocky mountains adjacent to the Canadian Pacific Railway.

Prof. Fay knows his subject thoroughly, for he took part, with other members of the Appalachian Club of Boston, in many of the first ascents and in the exploration of these mountains over fifteen years ago, and since then has been back many times to the Canadian Rockies. He divides his article into two parts. (1) The Physical Characteristics, and (2) Exploration and Alpinism. In the first part he compares the Rockies with the Alps. A very useful outline of the natural features of the region is given, and the physiography and geology of the mountains are considered. The flora and the fauna of the district are also touched on, but the author quite rightly reserves most of his enthusiasm for the wonderfully beautiful valley scenery, "the exquisite lakes, or rather lakelets, perhaps unrivalled anywhere," also "another feature wherein the Canadian Rockies are almost without a peer—the remarkable waterfalls," etc.

In the second part we have a short historical account of the earlier exploration of the Rockies in the days of the fur trade, then of the Palliser expedition, and, finally, of the work that has been done since the opening of the Canadian Pacific Railway. The whole is a most useful contribution to our knowledge of the Canadian Rocky mountains.

J. N. C.

'The Making of a Great Canadian Railway.' By F. A. Talbot. (London: Seeley. 1912. Pp. 349. *Map, Diagrams, and Illustrations.* 16*s.*) The railway in question is the Grand Trunk, and the story of the making is well worth telling. A route which penetrates the western mountains to a first-rate natural port, with no higher summit-level than a few feet over 3700, must clearly influence profoundly the development of the Canadian North-West, and it is remarkable to read of the haulage of grain from the western wheat-fields over the mountain section to Prince Rupert, and of shipping it there for Europe, in preference to conveying it by rail to Atlantic waters direct. The book is thoroughly readable, has its share of romance, is instructive and yet not too technical, and is well illustrated.

'Britain across the Seas: America.' By A. G. Bradley. (London: National Society's Depository. [*N.d.*] Pp. xv. and 454. *Maps and Illustrations.* 12*s.* 6*d.*) This is a valuable history of the British Empire in America, mainly, of course, devoted to Canada, but including also the West Indian territories. The writer's name is sufficient guarantee of the authority of the book. The illustrations are profuse, and are taken from early engravings as well as recent photographs. The book is made of an unfortunately stiff heavy paper.

'Porter's Progress of Nations.' Edited by R. P. Porter. (London: Routledge. 1912. *Maps and Illustrations.* 1*s. each.*) 1. Alberta. By L. Thwaite. (Pp. 250.) 2. Chile. By P. Ganto. (Pp. 251.) This series, as at present announced, is intended to include South, Central, and North American, and Far Eastern series. The principal intention, from the two volumes under notice, would appear to be to bring before readers in a practical manner the methods and possibilities of the development of new lands in the various territories. The subjects principally treated are social and economic, although history and physical characteristics also receive attention. While the texts have no strongly marked feature, the volumes give evidence of careful preparation and editorship, and excellent production, considering the extremely small price. In some details the rapid development of Alberta especially will necessitate early revision in the volume on that territory.

'Stanford's Compendium of Geography and Travel: Central and South America.' Vol. 2. 'Central America and West Indies.' By A. H. Keane; edited by Sir C. R. Markham. (London: Stanford. 1911. Pp. xxvi., 496. *Map and Illustrations.* 15*s.*) Such revision as has been necessitated in this new issue has been ably supplied. In the direction of geographical research, not much was called for; the work has lain rather in the direction of political and economic affairs.

'Salvador of the Twentieth Century.' By P. F. Martin. (London: Arnold. 1911. Pp. xv., 328. *Map and Illustrations.* 15*s.*) This is a detailed survey of the republic of Salvador, chiefly on historical and economic lines. In the later chapters, however, the country is described in some detail, department by department, with reference to soil, climate, and other physical conditions bearing on the economic conditions and possibilities of the various districts. The map is good; being on a scale of some 15 miles to the inch, it is able to show not only the railways, but the main roads, and the relief is well executed. The author has very strong views on the position of British trade in relation to foreign competition in Salvador.

'Picturesque Paraguay.' By A. K. Macdonald. (London: Kelly. 1911. Pp. 498. *Illustrations.* 16*s.*) In the now extensive literature on South America there was room for a volume on Paraguay, and the present is a comprehensive work. If it fails, however, to leave a distinct impression in any particular department it is in that of picturing the country itself from the physical standpoint. The chapter specifically devoted to this topic is very brief and dismissed almost to the last. But the life and economic conditions of the country are treated in high detail and well illustrated.

'Argentine Plains and Andine Glaciers.' By W. Larden. (London: Fisher Unwin. 1911. Pp. 320. *Map and Illustrations.* 14*s. net.*) This book is avowedly a personal narrative, but it has added to it a collection of statistics and other details which give it an additional value for reference. It is hardly necessary to state that the writer is a keen observer, and his power in this direction enables him to furnish information of more than usual value on various topics—meteorology, for example, also plant life, animals and insects, especially those which (like the locust) have a direct influence on human activities. A glossary of Argentine expressions is a useful feature.

'Peru of the Twentieth Century.' By P. F. Martin. (London: Arnold. 1911. Pp. xx., 348. *Map and Illustrations.* 15*s.*) The interest of this book is mainly economic; indeed, it might be questioned if the physical characteristics and description of the country are properly dismissed so lightly as in ten pages. Of the government and administrative arrangements a complete sketch is given, but some two-thirds of the text are devoted to the products, industries, and commercial possibilities of the country, and to subjects akin thereto. The copious and detailed statistics provided in certain sections will need early revision if they are to retain their value.

AUSTRALASIA AND PACIFIC ISLANDS.

'My Tropic Isle.' By E. J. Banfield. (London: Unwin. 1911. Pp. 315. *Illustrations.* Price 10*s.* 6*d.* net.) Having purchased an island off the Barrier Reef coast of Queensland (Dunk island, as one discovers from a single reference in the book), the author quitted civilization to dwell therein, and these sketches are the outcome. The author is a keen amateur naturalist, and the denizens of the island, after a personal and general introduction, are his chief topic. The

descriptions are charmingly written; it is hardly an effort to forget the text and to feel the sun in one's face. The book is well got up; the illustrations especially being of unusual merit.

'The Romance of Australia.' Edited by Herbert Strang. (London: Froude. [*N.d.*] Pp. xi., 640. *Map and Illustrations.* 6*s.*) A collection of excerpts on the history and early settlement of Australia has here been added to the 'Romance of the World' series. They are judiciously arranged in four groups, dealing with the search for the southern continent, the early settlers in Australia, the trans-Australian journeys of exploration, and "adventures in the bush." The books from which the excerpts are taken are mostly recognized standard works or classic narratives, and in their original forms do not make the popular appeal (especially to the young) which in this volume they are made to do. Such is the justification for the volume.

'History of Australasia.' By A. W. Jose. (Sydney: Angus & Robertson. 1911. Pp. xiv., 319. *Maps and Illustrations.* 3*s.* 6*d.*) The fact that this book has reached a fourth edition shows that it has found a place in the literature of Australasia. In the present issue new chapters have been added on land settlement and the growth of industries in Australia. The chapters have also been in some measure rearranged, and the book is consequently easier to consult on a particular territory.

'Through Polynesia and Papua.' By F. Burnett. (London: Griffiths. 1911. Pp. xv., 197. *Map and Illustrations.* 12*s.* 6*d.*) The Society, Cook, and Solomon islands are the chief groups dealt with by this author, in addition to visits to New Zealand, Australia, and Papua. The native races form his principal subject, but flora and fauna claim some attention, in addition to the usual miscellanea of travel; the book also may be remarked upon for its outspoken criticism of the white man's influence in certain directions in the Pacific, and of a particular department of British administration.

'Islands of Enchantment.' By Florence Coombe. (London: Macmillan. 1911. Pp. xix., 382. *Map and Illustrations.* 12*s.*) Melanesia is this writer's field. As in the work previously noticed, the native peoples claim most attention, but the point of view is wholly different, and the study of them more intimate. Folk-stories take an important place. A praiseworthy feature of the book, from the geographical standpoint, is provided by the notes on the natural features of the various islands visited, which are given their proper prominence at the opening of each chapter.

POLAR REGIONS.

Arctic Researches.

'Campagne Arctique de 1907.' Duc d'Orléans. Bruxelles: Charles Bulens, 1911.

Two parts have appeared of the scientific results of the Duke of Orlean's expedition to the Barents and Kara seas and Novaya Zemlya in 1907. Others presumably are to follow. The first of these parts contains the log of the *Belgica* by her commander, A. de Gerlache, and papers on the meteorology by A. de Gerlache, terrestrial magnetism by A. Nippoldt, and atmospheric electricity by G. Lüdeling, besides a number of admirably reproduced photographs, and two maps, one on a large scale of the Matotchkin Sha in Novaya Zemlya. It is not very clear why an appendix should have been added containing a list of the soundings taken by the Duke of Orleans in 1909 in the Greenland sea, which have no special bearing on this expedition. The second part contains a study of the deep-sea deposits by Prof. J. Thoulet, and a list of the soundings taken.

Of these deposits fifteen were obtained in the Kara sea around the southern end of Novaya Zemlya, three in the Barents sea at the northern end, and a solitary one in the middle of that sea towards Norway. It is unfortunate that in her other soundings across the Barents sea the *Belgica* did not manage to get bottom samples, for that is where they would prove most instructive. The deposits obtained show a uniformity throughout; muds with a small proportion of sand, and very poor in calcareous and organic matter.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Seismology.

'La Sismologie Moderne.' Comte de Montessus de Ballore. Paris, 1911.

The writer of this popular introduction to seismology is well known as the author of two larger and more detailed volumes on 'Géographie Séismologique' (1906) and 'La Science Séismologique' (1907), both of which have taken their places as standard works. The old seismology is defined to be that of Mallet and his successors, and is supposed by the author, in common with other foreign seismologists, to be based on the error that the seismic focus is a point, though Mallet clearly saw that this was not the case. Modern seismology starts from the realization of the magnitude of the focus and from the wide registration of the unfelt earth-waves. The author describes a few of the more important seismographs and their records, the methods of determining the depth of the focus, the phenomena of earthquake-sounds, after-shocks, and submarine earthquakes, the distribution of earthquakes in time and space, and the origin of different kinds of earthquakes, concluding with an account of the earthquakes of France and her colonies, and the construction of buildings in earthquake-countries. The most useful chapters, perhaps, are those on seismograms and the geographical distribution of earthquakes, the latter subject being one to which the author has devoted much time and labour. On the whole, the treatment, though popular, is clear and accurate; but here and there are statements—such as those on the precedence of the shock by the sound (p. 95) and the predominance of earthquakes in winter (p. 169)—which are open to question.

C. D.

Glaciers.

'Characteristics of Existing Glaciers.' By W. H. Hobbs. New York and London: Macmillan. 1911. xxiv. + 301 pp., 34 plns., 140 figs. 13*s.* 6*d. net.*

Glacial problems continue to provoke lively controversy, to which Prof. W. H. Hobbs, of the University of Michigan, contributes a discussion of the bearing of recent observations on three chief types of glaciers, viz. those on the mountains of temperate zones and in the Arctic and Antarctic regions. The book is based on three articles, of which the first, on "the Cycle of Mountain Glaciation," was published in the *Geographical Journal*. The text of the articles has been greatly extended and they are illustrated by an excellent series of photographs and many instructive sketch-maps. Each chapter has a useful list of references, which include most of the best recent literature. Prof. Hobbs considers the land-ice of the three regions separately, as he regards their glaciers as essentially different. In the temperate regions the land-ice occurs in two chief forms—broad ice-sheets and valley glaciers; some of the former still survive in Scandinavia, and they were once widespread in various parts of North-Western Europe, Canada, and the northern parts of the United States. He describes such ice-sheets as levelling agents, whereas he attributes great

powers of corrosion to the valley glaciers which flow from them. He represents these glaciers as deepening their valleys so rapidly that they form steep cliffs and produce the most rugged of all topographic forms. Prof. Hobbs is, perhaps, disposed to overestimate the dependence of cliffs upon glaciers, as in his remark (p. 91) that "To-day, wherever rock climbing is indulged in, there glaciers are to be seen, or the evide ce of their former presence is everywhere overwhelming. It is the sapping process active in cirque recession and in valley widening which has here developed the nearly vertical rock face."

The Arctic glaciers he describes as ice-sheets which, except in Franz Josef Land, are smaller than the land on which they rest, whereas the Antarctic glaciers owing to the different conditions of their snowfall, are larger than the lands they cover. He accepts the view that the Antarctic ice, with its flat-topped floebergs, is due to accumulations of snow, and is not composed of glacier ice like the huge Arctic icebergs.

The differences in glacier controversy are often less important than they seem. They are sometimes largely verbal and questions of degree, as in the question of cirque formation, which is discussed in the author's first chapter. There are three main theories of the origin of cirques. According to Prof. Bonney, whose view was subsequently accepted by Sir Archibald Geikie, they are pre-glacial hollows cut by convergent streams, and with the walls usually modified and abraded by ice. The second view is that established by Richter, and adopted amongst others by Prof. de Martonne for the cirques of the Balkans. This view attributes their formation to the action of frost, which converts the slopes around a sheet of ice resting in a hollow into steep cliffs. It is thought that the daily freezing and thawing of water in cracks through the rocks leads to their disintegration, and blocks are dislodged and fall as talus on to the ice, which removes them. The flatness of the cirque floor is attributed to its protection by the ice.

According to the third view, which in its present form is due mainly to Willard Johnson, corries are due to the same shattering action as in the frost theory, but it is said to be most powerful on the margin of the ice, and to take place below the surface of the ice and not above it as in Richter's theory. Each of these three theories attributes the corries to combined water and ice action; the difference between them depends mainly on the relative importance attributed to the two agents. Prof. Hobbs lays much stress on the action of patches of snow producing the hollow which grows into the corrie by disintegration of the rock beneath them.

Prof. Hobbs does not reply in detail to the recent papers which lay stress on the protecting action of ice. In a comparatively short monograph of this character he wisely prefers to state his own views rather than to discuss in detail the alternative explanations.

J. W. Gregory.

GENERAL.

Early Printed Books.

'Catalogue of a collection of early printed books in the Library of the Royal Society.' London: Royal Society. 1910.

Most of the books here dealt with formed part of a collection presented to the Royal Society in 1667 by Henry Howard, afterwards sixth Duke of Norfolk, whose grandfather, the Earl of Arundel, had purchased many of the books in Vienna during his embassy in 1636. A number of them had previously been the property of Bilibald Pirckheimer, of Nuremberg (known to geographers

as translator of Ptolemy), to whom they are said to have passed from the library formed by Matthias Corvinus, King of Hungary. In these circumstances it is at first sight singular that few of the books in the present collection have any concern with geography, but this may be due to the fact that only a selection of Pirckheimer's books came into the hands of the Earl of Arundel. One or two of them, however, are of interest from our point of view, particularly 'Quattuor Americi Vesputii Navigationes,' usually found as a supplement to Waldseemüller's 'Cosmographiæ Introductio,' but which, as is shown by the signature "A" on the title-page of the few separate copies in existence, must have also been issued independently, though no mention of such an issue is made by Prof. von Wieser in his introduction to the recent reprint of Waldseemüller's work. The present example does not seem to have been known to Harrisse, who in the supplement to his 'Bibliotheca Americana,' p. 34, quotes only two copies of the separate issue. Other geographical works included are: The 'Cosmography' and other writings of Pope Pius II.; the first edition (1527) of the 'De Geographia' of Glareanus; Piccolomini's 'Della Grandezza della terra et dell' acque'; Werner's treatise on map-projections (1514) accompanying his translation of Ptolemy's first book; and the Latin version (1508) of Fracan's 'Paesi novamente ritrovati.' The example set by the Royal Society in issuing a special catalogue of these early printed books in its possession is one that might be followed with advantage by others.

'L'Atlantic.' By J. Lhez. (Tarbes. [*N.d.*] Pp. 492. *Maps and Illustrations.* 5*fr.* 50*c.*) This guide is intended for passengers travelling from Europe to South America. It is in convenient but unattractive form, the information being furnished on a condensed, and for the most part, tabular plan, and being intermingled with advertisements. The book, and especially the maps and plans, are very roughly printed, and the plans are in some cases quite illegible.

'Fore and Aft.' By E. Keble Chatterton. (London: Seeley. 1912. Pp. 347. *Illustrations.* 16*s.*) Mr. Chatterton adds this "story of the fore and aft rig from the earliest times to the present day" to other well-known works on ships and shipping. It is an interesting branch of the general subject, which makes claims upon the history not only of navigation at large, but in particular upon that of exploration. Diagrams of a variety of vessels are given, and the author ranges very widely for his examples.

THE AUSTRALASIAN ANTARCTIC EXPEDITION.*

Since outlining my plans in the *Geographical Journal* of June last, financial and other considerations have induced me to slightly modify the intended procedure. The first and most important departure from the original scheme has been the establishment of a station at Macquarie island. Apart from the general scientific results accruing from this station, its function as a wireless repeating station, connecting our Antarctic base with Australia, was deemed of sufficient importance to determine its adoption. By this wireless communication, which we hope

* This Report was commenced by Dr. Douglas Mawson, leader of the expedition, but that portion subsequent to the landing at the main base is added by Captain Davis. The Report was specially prepared for the Royal Geographical Society.

shortly to effect, we will be able to establish a fundamental longitude at our main Antarctic base. The *Aurora* left Hobart on December 2, 1911, and encountered a heavy gale, which happily was weathered without much damage. A landing on Macquarie island was effected between the dates of December 11 and 24. During this period the auxiliary vessel, s.s. *Toroa*, arrived at Macquarie island, and a party of five men, also coal and stores, was placed on shore, and the masts for the wireless station were erected. The *Toroa* returned to Hobart, and on Christmas Eve the *Aurora* continued her voyage to the south. The first ice was met in lat. 64° 15′, long. 156° 10′ E., and very shortly afterwards a loose line of pack appeared, into which the *Aurora* pushed her way. The pack became so heavy eventually that southward progress was absolutely barred in lat. 65° 40′ S. and long. 156° 30′ E. It now remained for us to coast along the pack to the westward in quest of slacker ice conditions to the south. The *Aurora* was headed towards these lesser-known regions, and for several days was enveloped in a pall of fog. She threaded her way through loose ice and lines of pack in search of a possible southern lead. The sea in this region was found to be heavily encumbered with dense pack-ice and enormous bergs. Not until the morning of January 5 was a change experienced, when, the fog lifting, we found adjacent to us a wall of barrier-ice. A three days' blizzard intervened before we could prosecute further investigation. With the advent of settled weather, Captain Davis headed the vessel southward through the slacker ice into the unknown waters of a great bay, since named Commonwealth bay, situated at the western extremity of Adelie Land. The Antarctic coast-line is here mainly of the nature of an ice-wall, the front of Piedmont glacier slopes, relieved by occasional rocky headlands and hundreds of rocky islets. Thick weather, alternating with frequent blizzards, added difficulties to our accomplishing a successful landing.

On January 19 the general stores for the first and second parties together with twenty-five tons of coals had been safely landed at the main base. At 8.45 o'clock that evening the *Aurora* sailed out of Commonwealth bay, and continued her voyage to the westward, coasting along the edge of Adelie Land at a distance of from 5 to 10 miles. We passed several small islands close in shore, and also many large icebergs. On the following day, at 8.30 a.m., we found our way westward barred by a mass of heavy pack and bergs. These extended right up to the land, and we were obliged to go northward as far as lat. 65° S. before we were able to make much westing again. Continuing about this parallel as closely as the ice would allow, we expected on the evening of January 21 to sight Côte Clarie. At 1.30 a.m. on that day we found the pack extending to the south-west, and after steaming west for 25 miles, we stood south in long. 132° 30′ E. Shortly afterwards we passed over the western edge of Côte Clarie, as marked on the chart. The water here was clear of pack-ice, but studded with a great number of immense bergs which conveyed to us the

impression that Côte Clarie had been an ice-barrier and had broken up since D'Urville's discovery. On January 23, at noon, in lat. 65° 2′ S. and long. 132° 26′ E., we sounded in 160 fathoms in sand.

We continued our way south, and soon after, we passed over the position assigned on the chart to the land extending from Cape Carr eastward. Once more we sailed southward, and at 5.30 p.m. land was sighted to the southward, snow-covered hills of exactly similar appearance to that which we had already seen at Adelie land. Standing towards this land we were stopped at 8.30 p.m. at the edge of heavy pack floe-ice extending right up to the land, now apparently about 20 miles distant. This was in lat. 65° 45′ S. and long. 132° 40′ E., soundings revealing 230 fathoms with bottom of sand and stone. As we were unable to approach land more closely, in this direction, we now stood to the south-eastward, and at 3 a.m. we were within about 12 miles of the coast when further progress was impossible. Here we were able to see the edge of the land which presented the same barrier appearance except that it was a great deal more heavily crevassed than that we had previously seen. We now turned back again in an attempt to approach the land from the south-west, but soon found the pack extending to the northward until in long. 131° 15′ E. we lost sight of it—the sharp point appearing to be trending to the south-west.

During the next four days violent gales and heavy seas prevailed and we were blown some distance to the northward. But on January 29 we again made the edge of the main pack in long. 126° 10′ E., and lat. 64° 55′ S., we skirted the edge of this, and reached at noon lat. 65° 35′ S. and long 124° 7′ D.R., and the soundings here gave us 630 fathoms with rock bottom. Great difficulty was experienced in obtaining observations for position, owing to the constant overcast and foggy weather. We continued to follow the pack, and on January 31, good observations were obtained which placed us at noon in lat. 66° S. and long. 119° 30′ E., there being a depth of 340 fathoms with mud at bottom. We should now have been within ten miles of Totten's high land, but although the weather was perfectly clear nothing was seen to the southward but an immense collection of bergs and heavy floe ice. Here we found the pack trending to the northward again, and followed it up to lat. 65° S. and long. 116° E., at noon on February 1, when soundings were obtained in 927 fathoms, the bottom showing mud and stones.

The next two days were spent in coasting along heavy pack, and on February 3, we were in the vicinity of Knox Land, where it was hoped a landing place would be found for the second party. Here the pack appeared to be loose at the edge, and on February 3 we pushed into it. At noon of that day we were in lat. 65° 39′ S. and long. 108° 35′ E., soundings revealing 300 fathoms with sandy bottom. Shortly after noon we found further progress south was impossible. The floes were of immense thickness and there was no appearance of open water to the south. We therefore decided to go out and try further westward. On February 4

we again pushed south into the pack in long. 106° 52′, but were unable to get more than a few miles before we were brought up by heavy floes, many of them showing signs of severe pressure. This was in lat. 65° 7′, where Wilkes had found open water for 50 miles further south.

After a third attempt further west to penetrate to Knox Land, during which the vessel was badly knocked about and only extricated with great difficulty, we decided that it would be hopeless to try to reach Knox Land through nearly 60 miles of this pack. We therefore continued westward towards the position assigned by Wilkes to Termination Land, and on the morning of February 8, at 7.40 a.m., observed an ice barrier extending in a north-westerly direction. We followed this, and at noon were in lat. 64° 2′ S. and long. 9° 18′, this barrier was about 80 feet high, and on the eastern or windward side had a steep slope like the roof of a house extending back from the edge. It was not until the evening that we reached the northern edge of it. There it was found to trend sharply away to south-south-east. Soundings off the end of this barrier gave 870 fathoms, sand and small stones. On February 9, following the barrier to the south-south-east, we sounded at 5.30 p.m. 110 fathoms, mud and small stones. This was in lat. 64° 37′ and long. 96° 40′ E.D.R. A blizzard intervened during which we sheltered under the barrier. On February 12, we stood towards the south-west among a tremendous number of bergs and floes, which however were sufficiently loose to allow us to move onward. On February 13, at noon, we had reached lat. 65° 54½′ S. and long. 94° 25′ E., the depth having increased to 500 fathoms. At this time we had reached an ice barrier about 100 feet high. This was followed to the southward, and at 1 p.m. land was sighted, high and entirely snow covered, trending approximately east and west. At 4.30 p.m. we reached the edge of very old and heavy fast ice which was apparently extending over a distance of about 20 miles from the land. Mr. Wild and a party landed on the floe and made a short journey. On their return they reported that the ice was evidently several years' old and was of the same character for the whole distance they traversed. The lat. was now 66° 21′ S. and long. 94° 14′ E., while there was a mud bottom at 210 fathoms.

As it was out of the question to land a party on this ice, and our coal available for exploratory work was almost exhausted, we commenced our return journey to the northward, but on clearing the edge of the barrier we had met on the previous day, we sighted from aloft another high barrier to the eastward. We therefore again stood south-east, and discovered that the barrier we had been steaming along the previous day was very narrow, and that it was possible to steer south again a very few miles further east. Land was observed to the southward, and by noon we were up to the edge of fast ice, in lat. 66° 21′ and long. 94° 51′ E. in 182 fathoms. The high barrier seen during the morning was observed to extend as far as the eye could reach, and apparently was fed from the inland ice. Mr. Wild and a party landed on this floe and shortly afterwards got on the Barrier, which

was found to be composed at this place of blue glacier ice. They soon afterwards returned, and Mr. Wild reported that the glacier, which he described as very much like the great Beardmore glacier, showed very little signs of movement, and that excellent winter quarters could be erected there with safety. We therefore brought the ship close up to the glacier, and the work of discharging the stores and hauling them up to the top of the cliff was begun. The mean of a number of sights gave the position of the ship as lat. 66° 18′ 28″ S. and long. 94° 58′ E.

On February 19th the landing of the stores was completed, and after remaining another day at the base to remove the stores to a safe position, the *Aurora*, at seven a.m. on February 21, steamed for the north. We continued coasting along the edge of the barrier, which was found to be extending in a northerly direction until we reached lat. 65° S. where it appeared to trend sharply to the east. In character and appearance the barrier was very similar to the Ross barrier except that it was not quite so high, the average height being 130 feet. It was now dark soon after nine p.m., and we spent a very anxious night in the same collection of bergs and floes which we had met on our way south. In the darkness and mist it was often impossible to see where we were going, and it was a great relief to us when daylight revealed clearer water to the northward. Getting into this we soon came to the end of Termination barrier and continued along this to its northern extremity, where we found no pack but a good many bergs.

Regular bay, as found by Wilkes, appears to have been an extraordinarily heavy accumulation of pack during the season of 1840, as when we were on the southern side of the bay the heavy swell from the north gave us every indication of clear water in that direction. On our homeward journey to Hobart, we crossed its northern end in lat. 62° 20′ and long. 101° E., but there was no pack to be seen although a good many scattered bergs were in the vicinity. This was fairly late in the year, however; it may be that the pack which sets to the eastward around Termination barrier had gone to the westward earlier in the season.

The *Aurora* arrived safely in Hobart on March 11.

THE MONTHLY RECORD.

THE SOCIETY.

The Awards for 1912 have been given as follows: the Founder's Medal to Mr. Charles M. Doughty, for his remarkable exploration in Northern Arabia thirty years ago, and for his classic work in which the results were described; the Patron's Medal to Mr. Douglas Carruthers, member of the British Museum expedition to Ruwenzori some six years ago, who has since carried out three important and successful expeditions—in 1908 in Russian Turkestan, in 1909 in North-West Arabia, and in 1910-11 in North-Western Mongolia and neighbouring regions; the Victoria Research Medal

to Sir George H. Darwin, the leading authority on tides, and author of important studies in other branches of geophysics. Of the lesser awards, the Murchison Grant goes to Captain W. C. Macfie, R.E., lately in charge of the Uganda Topographical Survey, who in the space of twenty months accurately surveyed for the first time an area of 14,000 square miles in that country; the Gill Memorial to Captain F. M. Bailey, who in 1904 assisted in Major Ryder's survey during the expedition from Lhasa through Tibet, and has quite recently carried out an important journey from China to Assam by way of Batang and Rima on the upper Lohit, making a careful traverse of the route; the Cuthbert Peek Grant to Mr. Cecil Clementi, Assistant Colonial Secretary at Hong-Kong, who has carried out journeys and surveys in Southern China and elsewhere, the latest covering 4000 miles and extending from Andijan in Central Asia, through Chinese Turkestan, Kansu, and other Chinese provinces, to Hong-Kong; and lastly, the Back Grant to Mr. L. A. Wallace, for his valuable survey work in North-Eastern Rhodesia.

EUROPE.

The Rainfall of Scotland.—A special contribution to the study of the mean annual rainfall of Scotland is afforded by Mr. Andrew Watt, in the *Journal of the Scottish Meteorological Society* for 1910. The paper is illustrated by a fine coloured map, which shows a variation of rainfall from under 30 inches per annum along nearly the entire strip of east coast to over 80 inches over much of the western highlands and 100 inches in two patches on either side of the Caledonian canal. The rainfall is also heavy in the southern uplands and in the western islands. The period of which the records of rainfall have been mapped embraces the forty years 1871 to 1910, and it has been shown by Dr. Hann and Dr. Mill that forty years are sufficiently long to furnish a rainfall average not differing from the true average by more than about 2 per cent. A comparison between two little sketch-maps in Mr. Watt's paper of the mean annual rainfall and of the vertical relief of Scotland shows the general correspondence between the wetter and the more mountainous regions, but it also shows, what is now generally known, that elevated land can only provoke a heavy rainfall where it presents an exposure to the prevailing rain-bringing winds. Mr. Watt draws attention to a point also urged annually by Dr. Mill in "British Rainfall," namely, the totally inadequate representation of rain-gauges in the Highlands, and the desirability of more numerous gauges all over Scotland, as over the British Islands as a whole. We might here remark that since, in view of the extremely severe climatic conditions that necessarily prevail in so elevated and so northern a region as the Highlands of Scotland and the consequent sterility of soil and sparseness of population, rain records will never be furnished on a sufficiently extensive scale by private residents, or even by farmers or shepherds, as they are in many lowland parts of Britain, the responsibility of setting up rain-gauges in the wilder parts of the country rests with the local Scottish scientific societies, with the assistance, if need be, of scientific societies in England. It needs but the stimulation of public interests in a work not only of scientific interest, but full, also, of practical importance, to extend, and finally complete, the rainfall survey of the United Kingdom.

ASIA.

The Geographical Results of the Abor Expedition are discussed in articles in the *Pioneer* of Allahabad for March 8 and 29. As reference has

already been made more than once to the work of the survey parties while in the field, it will suffice to mention briefly the chief points brought out. The party which started up the Dihong early in January to visit the Shimong Abors proceeded several marches beyond Shimong, but was compelled to return owing to scarcity of supplies and lack of carriers. Although unable to reach the Sinji-Chogyal falls at Pema-koi-chang, described by Kinthup (*Journal*, vol. 38, p. 202), the column had followed that explorer's route for several marches, proving without a doubt the identity of the Tsangpo with the Dihong. The result is to justify the belief that Kinthup's account was correct in all important particulars. He spoke of the steep road south of Sinji-Chogyal, but mentioned no other falls, and always referred to the river as flowing south, and passing occasionally through stretches of level ground. A second column, which started at the same time for the exploration of the Panghi Abor country, proceeded direct to Geku, and was the first to explore the upper Dihong as far as Shimong, and to map the river beyond this point. A third column, sent out later, surveyed the whole of the Padam Abor country, in spite of the continuous rain in February. Other columns moved up the Shimong valley south of Rega and into the Galong Abor country, exploring and mapping previously unknown ground. Lastly, the surveyors with Mr. Kerwood's mission into the Miri country have explored the valley of the Subansiri river. Among changes introduced into the maps are the shifting of the course of the Yamne river, an important affluent of the Sanpo, considerably to the east of its supposed position, and the placing the big bend of the main river not at Shimong, but much more to the north, there having evidently been a confusion in the past between the Shimong river and the Dihong. The survey work involved the greatest difficulty throughout, owing to the dense forest, the mist and snow, and the entire lack of any transport but the carrier. The conditions may be appreciated from the statement that the troops while marching and fighting were reduced to half the amount of kit usually regarded as the irreducible minimum; were constantly wet through, with no tents or change of clothing; and, while never receiving a meat ration, always carried 50 to 60 lbs. of dead weight.

The Recent Fishery Survey of the Bay of Bengal.—A collection of papers connected with the Fishery Survey of the Bay of Bengal has just been issued at Bengal Secretariat Book Depôt in Calcutta. It shows that considerable progress has been made by the Government with a view to the provision of a large supply of food material for the people of the country from a source which has been hitherto neglected. As a first step towards the opening up of sea fisheries, it was considered essential that Government should undertake a systematic survey of the bay from the fishery point of view, so that the favourite haunts and periodic migrations of fish might be ascertained and recorded. To achieve this the trawler *Golden Crown*, built at Hull in 1896, was bought by the Secretary of State and altered and fitted out to suit the climate and the special requirements. It was placed in charge of a well-known trawling expert from Hull. During the first seven voyages to the Bay of Bengal the *Golden Crown* was engaged for thirty-five days in trawling, the weight of fish caught amounting during that period to an average of 2360 lbs. per day. Many of the fish were of species new to the public, and it will take time before these become familiar enough to come into common favour. Altogether 150 species were identified, and of these at least six were new to science. On the whole it has been proved that there are large areas in the bay in which trawling is possible, these potential fishing grounds being found practically everywhere between

the 10 and 100 fathom lines. The best catches were made during the quarter ended June, 1909, when the figures amounted to 33 cwts. per day. Generally the results obtained were such as to compare very favourably with those of first-class trawlers in England, though the main objects of the cruises were exploratory rather than immediately commercial. The Fishery Survey was closed by the end of December, 1909, it having proved that the bay will yield an ample supply of fish, and that the catches can be put on the Calcutta market in good condition; a chart has also been prepared which shows the best fishing-grounds. It now remains for private enterprise to step in and follow up a great potential industry.

The Commander Islands, Bering Sea.—Mr. E. K. Suvorof spent the summer of 1910 on the islands Bering and Copper, of which he gives a description in the *Izvestiya* of the Geographical Society of St. Petersburg, No. 6, 1911. Bering island consists of two parts, the northern low and the southern mountainous. In the former tundra predominates, intersected in some parts by low ridges. Five hills have the form of upturned boats, the two highest attaining the height of 577 feet. These are composed of basalt, which predominates in the northern part of the island, and also forms the two uninhabited islets of the group Arii and Toparkof. The southern part of the island is a chaos of ranges and detached summits, rising to a height of 2200 feet, and is almost inaccessible, except along the coast, the valleys of rivers flowing down from the mountains. The prevailing rock is tuff, generally fine grained, which easily weathers and falls to pieces. The tundras of the north are evidently due to the silting up of large lakes, and the same fate threatens those which still remain, including even the largest. These lakes, again, have been creeks cut off from the sea by the rising of the land. Raised terraces may be noticed in many places along the west coast. The Sarasmoie lake, 22 square miles, has had the reputation of being of enormous depth and exceedingly cold, but the deepest sounding taken by Mr. Suvorof was 57½ feet. The temperature on July 4 fell uniformly from 54°·3 at the surface to 50° at the bottom. On Copper island volcanic tuff and conglomerate are most conspicuous, but on the north-eastern shore are found dacite, basalt, augite, and hornblende andesites. Everything tends to show that the island lies on a line of fault, and the remains of animal organisms indicate that it came into existence in the Tertiary period. The process of upheaval has not yet come to an end. The inhabitants of the islands, a mixture of Aleuts with many other elements, number five hundred. They keep a few cattle and pigs, catch foxes, sea-bears, and sea-otters, as well as salmon (*Oncorhynchus*) in the rivers.

AFRICA.

Explorations in the Basin of the Sanaga, Kamerun.—The unknown areas in the interior of the Kamerun are little by little yielding to the energy of explorers, and one of these is the region north of the middle Sanaga, watered by the Mbam and its western tributary, the Nun. In April, 1911, the course of the Mbam between about 5° and 6° 30′ N. was investigated by Captain Winkler, and that of the lower Nun about the same time by Lieut. von der Leyen.* Reports on these journeys appeared in the *Deutsches Kolonialblatt* for September 15, 1911, and a further exploration of the Nun by the geologist, Dr. Mann, is described in the same journal for February 1, 1912. Both the Mbam and

* The fact of the junction of the Nun with the Mbam had not previously been established with certainty, its lower course being omitted altogether in some recent maps.

the Nun are too much impeded by rapids, falls, and shallows to be of any practical use for navigation, and they are little used even by the natives for this purpose. Their courses are in great measure bordered by gallery-forest, while the country at a distance from their banks forms a grass and tree steppe. The oil-palm and rubber-yielding plants (Kickxias and Landolphias) are found on the upper parts of the Mbam only. This river abounds in fish, and wild swine and buffalo roam the surrounding country. In its lower course the Mbam is known as Leba, a name which recalls the lake and river Liba reported to exist in this region some thirty years ago, the investigation of which was one of the objects set before him by the Polish traveller, Rogozinski. North and east of the Nun the land rises into a plateau some 3500 feet above the sea, deeply dissected by streams. The whole region is thinly peopled, and, as it is infested by the tsetse fly, neither cattle nor horses are kept. An ethnological line of partition separates the Balom, near the junction of the Mbam and Nun, from the Bamum tribes further north, who speak a distinct language. The trading operations of the Hausas reach this region.

The Height of Ruwenzori.—With reference to his paper on this subject in the *Journal* for December, 1911, Captain Henrici writes to the effect that when the paper was written he had not seen the results obtained by Captain Jack during the operations of the Anglo-Belgian Boundary Commission of 1907–08, as a mean of seven observations from four points (excluding one from a distance of 80 miles). They gave a height of 16,794 feet, the average distance of the stations being about 35 miles, and the coefficient of refraction used being 0·07. This, Captain Henrici says, is strong confirmation of his final figure, viz. 16,790 ± 20 feet, and points to the conclusion that Captain Behrens's result is about 70 feet too low. The value 16,790 may be taken to have a probable error not exceeding 10 feet, and is probably even more accurate than this implies.

Lake Mweru.—A report on the "Mission for the exploration of the interior waters of the Belgian Congo," sent out in charge of Dr. Stappers, has appeared in the December number of the *Renseignements de l'Office Colonial* (Brussels). It deals with an examination of Lake Mweru, mainly from the point of view of its fisheries, made during the second half of 1911. Dr. Stappers reached Mweru in August by way of the Luapula, which he had explored from Kasenga downwards. He describes the water-area as rather a swamp than a lake, though circumstances prevented him from completely sounding the whole. The greatest known depth is 15 metres (50 feet), but the whole central portion has a level bottom with only 6 to 8 metres. The Luapula deposits an enormous quantity of alluvium at the south end, making it impossible for a steamer to enter the river during the dry season. The bays on the south-west coast are nearly blocked with aquatic vegetation, and access to the station of Nkole is a matter of difficulty. A regular current is maintained from the Luapula towards the emissary of the lake. Observations showed the mean temperature of the water to be 25·5° C. (77·9° Fahr.) at the surface, and 23·5° C. (74·3° Fahr.) at 5 or 6 metres. The water abounds in plankton and suspended matter, and contains a considerable number of species of fish belonging to the characteristic African families. Fishing is regularly practised by the Wabemba and Wasera, who spend a large part of their time on the water. In reference to any systematic exploitation of the fishery in the future, Dr. Stappers points out that, owing to the shallowness, strict regulations would be necessary to prevent the extermination of the fish. The winds on Mweru are very capricious, and navigation in sailing vessels is thereby much hampered.

Dr. Kmunke's Expedition through Northern Uganda, to which reference was made in the April number (p. 398), reached Nimule on the upper Nile about the end of February, thus completing the traverse of one of the least-known portions of the Protectorate. The journey, which is said to have involved considerable difficulties, was continued from Elgon by way of Lakes Salisbury and Kirkpatrick and the districts of Nakwai, Lobor, and Kamchuru.

A New Territorial Division of the Belgian Congo has been promulgated by a Royal decree, dated March 28 last. The names and limits of the twenty-two new divisions are given in the *Mouvement Géographique* of April 7, which also shows the new arrangement by a map. The changes consist chiefly in the subdivision of the older units, especially in the interior parts of the colony, where some were of unmanageable size. In the west the divisions remain, broadly speaking, much the same as before. The total number, twenty-two, represents an addition of ten to the former number. Some readjustment of boundaries also takes place, particularly in the case of the Vice-Government-General of Katanga (now forming four separate divisions), which receives an extension of area, now reaching to the upper Kasai in the south-west.

The Falls of the Orange River.—In the *Transvaal Leader* of January 20, 1912, Dr. William Macdonald refers to the discovery and naming of the great falls of the Orange river, by George Thompson, in 1824, as described in the latter's book, 'Travels and Adventures in Southern Africa.' The name then applied, King George's cataract, has, Dr. Macdonald says, dropped out of the maps within modern times, being replaced by the Koranna term, "Aughrabies," or "great falls." He urges that the name bestowed by Thompson be restored. Should the native term, however, be employed specifically for these falls, and not be used generally for any falls, it is only in accordance with accepted canons of nomenclature that it should be retained. Dr. Macdonald points out that two travellers, both missionaries, viz. Campbell and Moffat, had approached very close to the falls before they were visited by Thompson, but had both turned back without actually reaching them. His statement that the falls exceed the Victoria falls in height can hardly be accepted as trustworthy.*

AMERICA.

Rainfall in the United States.—The cyclonic distribution of rainfall in the United States of America is discussed by William Gardner Reed in the *Monthly Weather Review* for October, 1911. The author pays a high tribute to the general work of the British Rainfall Organization, and to the light which it has thrown, under Dr. Mill's directorship, upon the study of cyclonic rainfall in the British islands; pointing out that the accuracy of the British rainfall work cannot be approached in the United States. In an area so large as the United States, containing arid areas at great distances from the sea, the water regions of the country show an influence upon the distribution of rainfall such as is not apparent in a small island like Great Britain. Thus the Gulf of Mexico, the Mississippi valley, the Great lakes, and the Atlantic ocean all appear to increase to some indefinite extent the rain production of cyclonic depressions in their neighbourhood. Mr. Reed goes on to discuss the distribution of rainfall in the cyclonic area itself, and assigns reasons for this distribution not exactly in accordance with general views on the subject, at all events in

* By an obvious misprint in Farini's plan (corrected in the French version in the *Tour du Monde*, vol. **52**), the height of the "Hercules" fall was given as 395 (for 195) feet, but, even if correct, this would not justify the statement alluded to.

England. Dr. Mill has shown that in nearly all cases precipitation is heavier on the left side of the track of a barometric depression than on the right, irrespective of its direction of travel, which in the British islands is usually from some point of west to east, and in explanation of this fact a purely dynamical or meteorological cause has been assigned. Mr. Reed, however, finding the rainfall distribution in the United States complicated by the local water areas, apparently concludes that such topographical features are the only causes concerned in the unsymmetrical distribution of rainfall in a cyclone. "In cases," he says, "where the heavy rainfall occurs on the track or near it we should not expect to find the rain area symmetrical with respect to the track. There should be a greater part of the area of heavy rainfall on the side of the track towards large water bodies, or the side from which the rainy winds come. Mill has shown that this is the left of the track for the British isles." But in the case of the ordinary eastward moving cyclone of the British isles, the heaviest rainfall occurs, in accordance with Dr. Mill's rule, on the left side of the path of the cyclone, that is to say with easterly and north-easterly winds, which in more ordinary circumstances are dry winds in the British isles. The persistent and heavy character of rain associated with east wind in England, lasting often from twelve to forty-eight or more hours, has nothing whatever directly to do with water areas, but is concerned with the circumstance that the east wind is then blowing in the left hand portion of the travelling cyclonic system. In rarer instances, when a cyclone moves westward, the heaviest precipitation is then with the westerly winds on the left side of the system. A dynamical explanation of this relation has been given as aforesaid.

Dr. Hamilton Rice, who, previous to starting on a new exploring expedition in the northern interior of South America, went through a course of instruction at the Society, writes to Mr. Reeves from Bogotá, under date March 8, 1912, stating that he was then about to make an early move towards his field of work. He had met with much help and encouragement from the Colombian Government, and had also the prospect of co-operation from the Survey Department of Venezuela. The long-continued drought, which is having a serious effect in Colombia, had somewhat hindered his preparations, as the lowness of the river had prevented the ascent of the mail steamers. He had sent on ten mule-loads of supplies and goods over the Andes to San Martin, and had arranged for two canoes to be built for him and to be ready for use at Caño Grande by May 1. After reaching San Martin, he proposes to descend the Ariari river to the Guaviari, then crossing into the basin of the Uaupes, and completing the map of its two upper branches. Afterwards he hopes to work on the Inirida and Guainia rivers, eventually making his way to the upper Orinoco, and, crossing into Brazil, reaching the Rio Negro by one of its tributaries. In this region, curiously enough, he will once more be working in a field which is engaging the attention of Dr. Koch-Grünberg (*Journal*, April, 1912, p. 400), but the latter's researches, it will be remembered, are chiefly concerned with ethnology.

Peru-Bolivia Boundary.—Information has been received from Colonel A. J. Woodroffe, R.E., who is in charge of the Peruvian section of the commission which has been engaged in delimitating the boundary between Bolivia and Peru. The first season's field work has been brought to a successful termination, but it has been of a most arduous nature. Much of the work was done at altitudes varying from 15,000 to 17,000 feet, the highest point observed being 19,829 feet. It can be but very rarely that peaks of over 19,000 feet have to be dealt with by surveyors engaged on boundary work.

AUSTRALASIA AND OCEANIC ISLANDS.

The New German Expedition to the Kaiserin Augusta River.—This expedition (*Journal*, vol. **38**, p. 537) has probably by this time begun its labours, as the leader, Dr. Stollé, and most of his coadjutors sailed from Genoa at the end of December, while the vessel built at Hong Kong for the navigation of the river left that port for its destination early in February. Dr. Stollé took part as geologist in the previous expedition under Dr. L. Schulze.

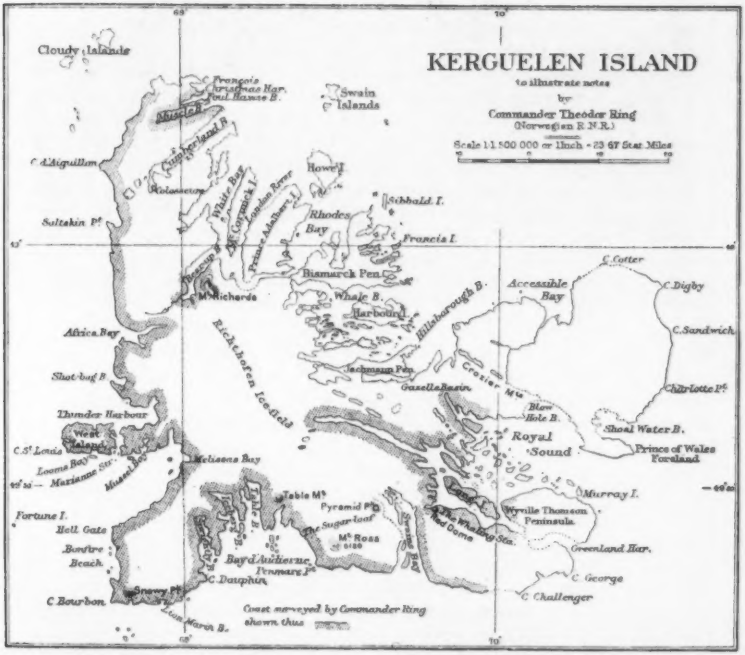
An Expedition in North-West Australia.—Mr. Charles P. Conigrave, a Fellow of this Society, informs us that he has undertaken a scientific exploration of the unknown area in the extreme north of the Kimberley division of Western Australia, between Cambridge gulf and the Drysdale river, which runs north to a point near the northern extremity of the division. He had started from Wyndham on Cambridge gulf, and when writing in September, 1911, was on the Forrest river on his way north through the unexplored area. The return would be made by the coast as far as Mount Casuarina, which he hoped to ascend. Part of his expenses are being borne by the Government of Western Australia.

The South and West Coasts of Kerguelen Island.—Commander Theodor Ring, acting for a Norwegian whaling company lately established in Kerguelen, has during the past few years been able considerably to rectify the chart of the west and south coasts of the island, which he has twice circumnavigated. The map on p. 495 is based on a rough sketch sent by him, showing the alterations necessitated by his surveys. In the British Admiralty chart the whole of the western half of Kerguelen has been but vaguely shown on the basis of reports by sealers and whalers, and various portions of the coast-line have to be shifted many miles; the general result being to widen the central part of the island, and to bring West island and other features a long way south of their position on the chart. Commander Ring sends a detailed description of the south and west coasts, from which the following items are extracted. Behind the whaling station, at the neck of the south-eastern peninsula, a plateau some 2000 feet high extends to the south coast. The neighbouring Red Dome gives a grand view all round, embracing the Crozier mountains in the north-east; in the north-west, the long fjord which runs west into the interior like a knife-cut, and (on a clear day) the great ice-field beyond; and on the west, the snow-capped Mount Ross and other peaks. Westward of Greenland harbour the south coast is high, but a valley runs from Swains bay behind Mount Ross towards an anchorage north of the Sugar-loaf (a curious monolith). Table mountain, east of Table bay, looks like an enormous short-stalked mushroom, and is visible far out to sea. On the east side and near the head of Iceberg bay there are hot springs, and the ground appeared to be covered with cinders. Cape Dauphin is bold and prominent, and the coast to the west is steep and imposing. An arm of the main ice-field of the island probably extends in this direction, and a glacier also descends towards Lion Marin bay. Cape Bourbon is low, but the coast from Bonfire beach to Melissas bay is almost perpendicular, glaciers descending into the sea at many points east of Hell Gate. Inside Marianne strait there is a splendid harbour, but Commander Ring had an exciting experience when finding his way in, first through fog and afterwards in a rising gale. Hot springs were again seen when walking overland to Mussel bay, and large trunks of trees were found stranded on the east side of the strait and in Thunder harbour. In the latter, one of the whalers had a narrow escape, avalanche after avalanche of ice-blocks being discharged by the glacier, forming a churning field of ice, some of which entered Marianne strait. Hereabouts,

KERGUELEN ISLAND. PART OF COAST-LINE BETWEEN CAPE BOURBON AND CAPE DAUPHIN.

CURIOUS FORMATION NEAR RED DOME, THE SLOPE OF WHICH IS SEEN ON THE RIGHT.

on a clear day, there is a magnificent view of the great central ice-field, which extends from Snowy peak in the south, almost to Mount Richards in the north, though separated from the latter by a valley.* On West island the most striking features are the gorge running inland north of Cape St. Louis, and the grand but sombre rocks of Monument cove. Sea elephants pass overland from the latter to Looms bay, as the intervening land is low. Footprints of a goat were seen here, and a new species or variety of gull with blue wings; but neither mice nor rabbits were noticed, though they abound on the east coast. Africa bay has two arms, and it was one of these, probably the northern, which



was sighted by Mr. Ring during an overland trip from Bear-up bay. The route led over a lower and an upper plain, both being traversed by a stream which descends from a glacier. From the ship, the great ice-field could be seen beginning to the south of the lower plain. North of Africa bay the coast is bold, and at Cape d'Aiguillon, and on thence to Christmas harbour, it has the same perpendicular form and forbidding aspect as in so many other parts of the island. At Christmas harbour the cairn erected by Captain Cook is still in existence, though now without the parchment left by him; and in the same neighbourhood is that recording the *Challenger's* visit.

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* Commander Ring proposes the name "Cook Glacier" for the great ice-field, but a part at least of this has already been named Richthofen ice-field by the German observers of the *Gauss* expedition, and it seems doubtful whether a second name is called for.

POLAR REGIONS.

Discovery of Norse Relics in South-West Greenland.—A lecture was recently delivered by Dr. Norman Hansen before the Royal Geographical Society of Copenhagen on the results of his researches in West Greenland, with a view to throwing light on the fate of the early Norse colonies in that country. These colonies, as will be remembered, have attained notoriety chiefly through the Vinland voyages of Leif Ericsson and Thorfinn Karlsefne in the early days of their prosperity (A.D. 1000–1050); but the history of the settlements has been traced in all through some 400 years until, in the fourteenth century, all communication with the outer world ceased, and their eventual fate has been shrouded in impenetrable mystery, no trace of European blood being found among the Eskimo when revisited in later times. In view of the known readiness with which European blood is absorbed in mixture with the Eskimo, it has been held, in particular by Dr. Nansen, that the disappearance of the old colonies can be accounted for in this way, the Eskimo being considered too peaceful in disposition to have exterminated the settlers by force. Dr. Norman Hansen thinks that this peaceable character may not have been shared by the Eskimo of earlier times, and his researches on the spot are held by him to support the view that it was to Eskimo aggression, in the period of their decline, that the ultimate extinction of the colonies was due. In association with the Rev. Eric Jespersen, minister at Julianehaab, Dr. Hansen proposed to penetrate into the almost unknown mountains which form a barrier to the inland ice; and parties of Eskimo were sent in advance to prospect. Ruins having been reported by one of these parties, the travellers started inland from the ancient church ruin near Kagsiarsuk in the Igaliko fjord, and, crossing some low ranges, reached a glen in which two glacier streams united into an unfordable river. Farther up, on the far side of one of the streams, the sure sign of the presence of ancient ruins was detected in the form of flower-strewn meadows. By ascending to the glacier so as to turn the stream at its head the spot was reached, and the unmistakable stonework of Norse homesteads was found half covered by sand—eight narrow compartments clustered in the midst of a meadow, which had still the appearance of having once been tilled. Nearer the glacier the remains of a Norse tomb were also found. Dr. Hansen considers that the position of the ruins in the angle between two unfordable glacier streams clearly indicates the site as that of a last refuge of the settlers when driven out of their homes in the valleys. While this is no doubt a plausible explanation, Dr. Hansen hardly succeeds in showing that it is the only possible one. He intends taking up afresh the discussion of the Vinland voyages, holding that the Saga's description of Karlsefne's journey can only apply to a route south along the Labrador coast.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

Past Climatic Changes.—While the evidences of great fluctuations of climate about the end of the Tertiary epoch, culminating in the series of cold periods forming the great Ice Age, are well marked in Europe and North America, no such clear proof of a similar state of things has yet been obtained from Eastern Asia, and it has been doubted whether the conditions of the glacial epoch extended to Japan and neighbouring countries. In a recent issue of the *Journal of the College of Science*, Tokyo University (vol. 32, Art. 5), Mr. M. Yokoyama claims to have obtained evidence, from a study of Japanese Pliocene and post-Pliocene fossils, that, far from having shared in the cold on the opposite side of the world, Japan during the diluvial period

enjoyed a climate warmer than the present. Unfortunately, the evidence for the correlation in time of the successive beds spoken of with their supposed counterparts in Europe and elsewhere is not so clearly stated as might be wished. From the markedly boreal character of the Pliocene fossils lately obtained from Koshiba, near Yokohama, as compared with those of the Upper Pliocene near Tokyo, the writer concludes that the temperature in this part of the world was *rising* during the latter part of the Pliocene epoch, and this suggested that the coral-bed of Noma, south of Tokyo bay, might be of diluvial age. This, Mr. Yokoyama says, has proved, on examination, to be the case; and as this bed contains forms which now inhabit tropical seas only, we have clear indication that the climate of that part of Japan was then much warmer than at present, and that the changes of temperature have there been in the reverse direction from those in Europe and America. After discussing other possible causes of a greater warmth in Japan at the time in question, he concludes that the only supposition which meets the case is that of a displacement of the poles, such as has been called in by other observers to account for puzzling facts in faunal distribution. These conclusions, if substantiated, would supply a certain support for Simroth's much-discussed "Pendulation" theory; but the weak point seems to be the absence of rigid proof of contemporaneity of the European and Japanese formations.

The Austrian Summer Cruise in the Adriatic, 1911, is described, and its main results are summarized, in the *Mitteilungen* of the Vienna Geographical Society, 1912, parts 1, 2. Observations were taken along the same cross-sections as in the previous cruises (see *Journal*, vol. **38**, p. 322: **39**, p. 80), and soundings were carried out in the deeper basins. The *Najade's* earlier results from the supposed deepest part were fully substantiated, no depth greater than 1132 metres (619 fathoms) being obtained. On the other hand, in the subsequent cruise of November-December, 1911, a depth of 1223 metres (669 fathoms) was obtained in the basin between Bari and Ragusa, this being the maximum so far found by the *Najade*. The temperature and salinity observations have again brought out some interesting facts. A line running down the axis of the sea divided its northern and central parts into a western half with surface temperature above 25° C. (77° Fahr.), and an eastern with one lower than 25° C. At two stations in the former the high temperature of 27° C. (80·6° Fahr.) was reached. The colder eastern water was found to have a fairly high salinity and is therefore not derived from the fresh water of the Karst, but is sea-water from the lower layers which rises owing to the action of the off-shore winds prevailing in summer. In spite of the great heat at the time, the warming of the surface water reached to a surprisingly small depth, no doubt owing to the stagnation of the air during this hot period. The discontinuity layer occurred in places between 5 and 10 metres. While the surface temperature in the western half was the higher, the case was reversed in respect of the bottom layers, which were slightly warmer in the east. It seems as though the warm water were driven from east to west on the surface and returned at a lower level, while below the discontinuity layer the colder water appears to rise to a higher level in the west, and the warm water to sink to a lower level in the east. The distribution of salinity was also interesting, the density being least at the head of the gulf, and increasing progressively to the south-east, though with a decided southward extension of the less dense water along the Italian coast, and with an area of less dense water off the mouth of the Drin on the opposite side. This is clearly a result of the major currents, especially the flow of Mediterranean water northward through the Strait of

Otranto. A comparison of the midsummer temperatures with those of mid-winter brings out (*inter alia*) the curious fact that in the depths some of the former were less than the latter.

A Catalogue of Destructive Earthquakes.—Under the auspices of the Seismological Committee of the British Association, Prof. Milne has issued a valuable "Catalogue of Destructive Earthquakes from A.D. 7 to A.D. 1842," a work on which he has been engaged for several years. The catalogue, which contains more than four thousand entries, is based on translations of Chinese, Japanese, and other old chronicles; on numerous memoirs of the earthquakes of special districts; and on information received through Government offices. In all probability, the catalogue is as complete as it is now possible to make it. Its value lies chiefly in its restriction to earthquakes of a high degree of intensity, to those in fact which have contributed most to the evolution of the Earth's crust. Yet, important as such shocks are, the number unrecorded amount to about 96 per cent. of the probable total, partly owing to the small area of the Earth occupied by civilized races in early times, partly to the fact that the majority of sub-oceanic earthquakes in all time are excluded. The analysis of the new catalogue cannot fail to throw light on the distribution of earthquakes in time and space. It will show us the regions which at different epochs were undergoing change most rapidly, just as the lists of world-shaking earthquakes which are published annually by the Seismological Committee indicate those in which changes are now taking place.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Ignatio Danti and the Wall-maps at the Vatican.—Of the wall-maps by which certain galleries of the Vatican were decorated in the sixteenth century under the orders of Pope Gregory III., one series, giving a general representation of the world, has been frequently described and is well known to visitors. Another and even more important series, concerned solely with Italy, has remained comparatively unknown, as the gallery containing it has only lately been thrown open to visitors in general. A good deal has been written on the author of these maps—Ignatio Danti—who was summoned to Rome in 1580 to superintend the painting of them, but as the other series, which is of much less importance to geographical history, has been erroneously ascribed to him, his reputation as a geographer has suffered somewhat in consequence. That series, which consists in the main of copies of maps which had been current in Italy some years before the decoration of the gallery, had, in fact, been almost completed independently of Danti when he took up his task. Geographers are now indebted to Dr. Everhard Schmidt for the first detailed account of the Italian series, which appears in the *Geographische Zeitschrift*, 1911, No. 9, and is written in full knowledge of all the existing literature on the subject. The maps—forty in all—occupy the sides of the gallery now thrown open as a communication between the collection of antiquities and the Capella Sistina, having a length of over 150 yards and a breadth of more than 6 yards. The larger maps, of which sixteen on each side occupy the spaces between the windows, measure some 12 feet by 8 feet; the smaller, at the ends of the gallery, only about 8 feet by 4 feet. The former delineate the political divisions of the whole of Italy, in two series separated by the Apennines, on a fairly uniform scale, though with varying orientation. It had been at first intended to represent the Papal dominions only, and for this purpose Danti, who had already done some original work in his survey of the country round his home at Perugia, devoted some time, while still professor at Bologna, to careful

surveys in the field. This fact gives to his wall-maps, the preparation of which occupied the three years following his move to Rome in 1580, a distinct importance in the history of cartography. For many parts of Italy first-hand data were not, of course, available, but that he made use of the best nautical surveys of the time is proved by the generally correct representation of the coasts. Relief is shown in a more or less crude fashion, little attempt being made to indicate the exact morphology of the mountains, though in this matter Danti is in advance of his successor, Magini. While the ornamentation has been renovated in more recent times, the maps themselves remain almost in their original state, and can be still regarded as genuine examples of sixteenth-century cartography. Danti is often spoken of as having taken a foremost part in the discussions on the reform of the Calendar, but the slight reference to this in his letters shows that it was but a subsidiary part of his work for Pope Gregory III.

Missing Journals of the First Dutch Voyage to the East.—The Linschoten Society—the worthy rival of the Hakluyt Society in this country—appeals to all interested in the history of travel in the hope of recovering three lost journals of the above voyage, carried out in 1595–97 under the orders of Cornelis de Houtman. In addition to four printed accounts which have come down to us, it is known that at least three others once existed, including (most important of all) that of the leader himself. It is suggested that notes or a copy of Houtman's journal may possibly have been kept either by him or his brother, and may still be in existence; that the original may have come into the hands of Middelburgh merchants, in whose interests Houtman made his second voyage; or that it may even have fallen into English hands through the Englishman, John Davis, who took part in that second voyage. Of the other journals, one, viz. that of J. J. Valckenier, must certainly have been used by Hugo de Groot when writing his 'De jure prædæ commentarius' in 1604–5.

GENERAL.

The 18th International Congress of Americanists, which, as already announced, is to be held at the Imperial Institute, May 27 to June 1, offers an excellent programme of 70 papers, divided into six sections, viz. Palæo-anthropology, Physical Anthropology, Linguistics, Ethnology and Archæology, General Ethnology, and Colonial History. Some of the most important will be: in Section I., Dr. G. MacCurdy on the recent discovery of human bones in a Pleistocene deposit near Cuzco, Peru; Dr. C. Peabody on the prolonged study of the Trenton gravels by T. Volk; Dr. J. B. Ambrosetti, "A Fossil Skull from Argentina"; and a discussion on Dr. Capitan's "Le Paléolithique en Amérique: état de la question." Dr. A. Hrdlička, in "Ethnic Nature and probable origin of the American aborigines," will give the results of his intimate knowledge of the structure of ancient and modern man. Amongst the discourses illustrated by lantern slides, Dr. E. Seler's on the "Ruins of Uxmal"; Dr. E. Hewett's, on the "Excavation of Quiriguá, Guatemala, by the American School of Archæology"; and Prof. M. Saville's on his latest expedition to Ecuador, will be of the highest interest. In section V., Mr. Waldemar Jochelson will give the "Results of the ethnological section of the Riabushinski expedition of the Imperial Russian Geographical Society, and E. Roquette-Pinto those of the Rondon Commission in Central Brazil. The full list can be obtained from the Assistant Secretary, 50, Gt. Russell St., London, W.C. Fees from Members (£1) and Associates (10s.) should be sent before May 15. There will be an evening reception at the Natural History Museum, and other entertainments and excursions are in contemplation.

The Tenth International Geographical Congress, which was to have met at Rome last autumn, has now been arranged to take place in the week beginning March 27, 1913, in the same city. Among other reasons, the celebration and trans-continental tour, organized by the American Geographical Society for the present year, have influenced the Italian committee in postponing the meeting till 1913. The new date fixed as the limit for notification of reports to be communicated is October 31, 1912, and for the submission of papers *in extenso*, February 15, 1913. Abstracts of communications must reach the executive committee not later than October 31, 1912, after which no proposals for such communications will be accepted. Members wishing to withdraw their subscriptions must return their tickets of membership to the Treasurer, not later than June 30 of this year. Revised arrangements for the reduced railway fares, and for the excursions, will be forwarded to members in due course.

OBITUARY.

Charles Beresford Fox.

THE death occurred on April 16, 1912, in Toronto, of Mr. Charles Beresford Fox, M.A., M.INST.C.E., a life member of the Royal Geographical Society, from the after results of an operation.

Mr. Fox, who was the eldest son of Mr. Francis Fox, of Alyn Bank, Wimbledon, was educated at Harrow and Trinity College, Cambridge, and was, until his departure for Canada, a partner in the firm of Sir Douglas Fox and Partners. Since then he has been a member of the firm of Messrs. Wragge & Fox, of Toronto.

He had travelled round the world, and was engaged as assistant engineer on the works of the Great Central Railway Extension to London, and afterwards in the construction of the large bridge across the river Zambezi at the Victoria falls for the Cape to Cairo railway. It was here that Mr. Fox met with a serious accident resulting in a fall of 100 feet, but being providentially caught by a solitary fig tree growing on the face of the cliff, his life was saved, although he was seriously injured. During the time he was in Rhodesia he was engaged for his firm and Sir Charles Metcalfe in surveying for several lines of railway, necessitating careful selection of route, and these lines have since been constructed.

He then proceeded to Egypt, and was on the Nile irrigation works for the Egyptian Government, his first duties as an assistant engineer being at the Assiut barrage; he surveyed considerable lengths of the Nile a few miles north of Khartum with a view to ascertain whether a safe and suitable dam could be constructed at the Shabluka gorge.

He was afterwards engaged on several important enterprises, including the Simplon tunnel through the Alps—which is the longest work of the kind in the world, its length being 12¼ miles. In driving this tunnel great difficulties were encountered owing to the high temperature of the rocks and springs of water. In the case of the former 54·5° C.—or 130° Fahr.—were recorded, whilst the latter attained 48° C., or 118° Fahr.

The last works with which Mr. Fox was connected before leaving England were the investigation in the St. Ives mines in Cornwall for radium, and the protection of the old church at Lyme Regis from the encroachment of the sea.

He was a first-rate shot with the rifle, and represented both his School and his University at Bisley, and also at a later date was selected as member of the team sent by Rhodesia to the National Rifle Association competition.

He was married in New York last year to Miss Evelyn R. Wheeler, youngest daughter of Mr. and Mrs. James A. Wheeler, of Merry Nook, New Brunswick, New York. His genial and generous disposition gained for him a large circle of friends, who deplore his premature death at the age of thirty-seven.

Dr. Richard Andree.

The well-known German ethnologist and geographer, Dr. Richard Andree, died on February 22, in his seventy-seventh year. To the public his name was best known in connection with the 'Handatlas' brought out by him in 1881, which has attained wide popularity in Germany as one of the best general atlases at a moderate price. This was, however, but a secondary product of his life-work, which in his later years had been more and more concentrated on the science of comparative ethnology. The son of Karl Andree, founder of *Globus*, and author of the classical work on the Geography of Commerce, Richard Andree was trained as a practical geologist, and his first literary production—his dissertation for his Doctorate in 1860—was on a geological subject. Six years later he brought out his first book, a narrative of travel in Scotland; and after various other works (including many contributions to *Globus*) had appeared from his pen, produced his first cartographical work in 1878 as joint author with Peschel of the 'Physikalisch-statistischen Atlas des Deutschen Reiches.' His 'Ethnographischen Parallelen und Vergleichen,' which also appeared in 1878 (followed by a second series in 1889), laid the foundation of his reputation as an Ethnologist—a reputation which steadily grew as a result of his subsequent publications in the same field. In 1891 he became editor of *Globus*, which reached a high standard of value under his capable direction. This he continued to exercise until 1903, when he resigned the chief responsibility, though still maintaining a warm interest in the serial until its final amalgamation with *Petermanns Mitteilungen* at the end of 1910.

Rear-Admiral Melville.

A striking personality has passed away in the person of Rear-Admiral George W. Melville, U.S.N., who died of heart disease at his home in Philadelphia on March 17. Descended from a Scottish family which made its mark in history, and grandson of James Melville, of Stirling, who emigrated to the States in 1804, he was born in 1841, and at the age of twenty joined the Engineer Corps of the United States Navy, seeing much active service during the Civil War, and in particular taking part in the capture of the Confederate cruiser *Florida* in the harbour of Bahia. As regards his professional career, it may suffice to say that his keen intellect and inventive faculty were of great service to the cause of naval engineering in the States, and that one of his last pieces of work was connected with the designs for the engines of the newest United States battleships. To geographers he is known, above all, for his interest in Arctic exploration, in which he took no mean part himself. His first Arctic service was in the expedition sent to rescue the survivors of Hall's ship, the *Polaris*, in which he did valuable work as engineer of the *Tigress*. Subsequently, in 1879, he took part in the ill-fated voyage of the *Jeannette*, whose commander found in him an invaluable coadjutor, particularly in the measures which he took to keep the ship afloat after first springing a leak, and in the harrowing experiences of the journey south after the final disaster. His heroic efforts to take relief to his comrades after himself reaching the Siberian settlements need not be dwelt upon. As is well known, the succour came too late to save them, but the journey (described in 1885, in Melville's book, 'In the Lena Delta')

was the means of clearing up all doubt as to their fate. A third occasion on which his aid was given to the work of rescue was when he joined the expedition for the relief of the Lady Franklin bay expedition, under Greely, in 1884. In later years Melville's name was associated with Arctic research through his scheme for testing the currents of the North Polar basin by means of specially constructed drift-casks, a number of which were set adrift in the Far North, some of them being afterwards heard of at points far removed from their starting points. He was keenly interested in Peary's efforts to reach the Arctic Ocean, and was throughout his consistent supporter.

Physically, Melville commanded attention from his massive head and stalwart figure, while his flowing hair and beard gave him in his latter days a patriarchal appearance. His portrait somewhat recalls the late Lord Salisbury.

Ralph Stockman Tarr.

Ralph Stockman Tarr, Professor of Physical Geography in Cornell University at Ithaca, N.Y., died after a short illness on March 21, 1912, in the full maturity of his scientific life.

Tarr was born at Gloucester, Mass., Jan. 15, 1864. He early showed an ambition to acquire a position in the scientific world, and was supported in this excellent object by a tenacious courage and a determined perseverance that enabled him to overcome obstacles which would have daunted a less persistent spirit. He entered the Scientific School of Harvard University, but was twice obliged to turn aside and engage in geological field work in order to gain means to complete his studies. After taking his degree at Harvard in 1891, he worked for a time in the Geological Survey of Texas, on the U.S. Geological Survey 1888 and 1891, and in 1892 was appointed Assistant Professor of Geology at Cornell, where he was in 1897 promoted to the professorship which he held at the time of his death. He was appointed special field assistant of the U.S. Geological Survey in 1903.

Besides making field studies in various parts of the United States, Tarr accompanied one of Peary's parties to Greenland; he spent the year of 1909–10 in Europe, and during several recent summers was engaged with his brother-in-law, Prof. Laurence Martin, of Wisconsin, in investigations in Alaska, with particular attention to the glaciers which there abound, this work being supported by grants from the National Geographic Society of Washington. He was the author of numerous reports and articles, but was best known by his text-books of physical geography, which are widely used and which have done much to introduce modern and rational ideas into the teaching of this branch of science in the United States.

Tarr was a member of the Geological Society of America, the American Geographical Society of New York, and the Association of American Geographers, and was president of the last-named society at its meeting in Washington last winter. He was to have taken part in the Transcontinental Excursion of the American Geographical Society next summer, in which he would have been an active and helpful member.

A. Lawrence Rotch.

The sudden death of Prof. A. Lawrence Rotch, founder and director of the Blue Hill Meteorological Observatory, near Boston, Mass., is likely to be an irreparable loss to science in America, for it will be long before an unselfish ambition to advance knowledge, and a high order of ability for the investigation of the atmosphere, are

again so happily combined with abundant means for providing material equipment as they were in this ardent and generous American.

Rotch studied at the Massachusetts Institute of Technology, from which he graduated, and of the Corporation of which he became later a member. He early showed an inclination for scientific meteorology, and about twenty-five years ago built and equipped his observatory on Blue Hill, the highest summit (635 feet) in eastern Massachusetts. A few years later a formal agreement was entered into with Harvard University, whereby the records and discussions of work on Blue Hill are published in the Annals of the Harvard College Astronomical Observatory, and a fund was at the same time set aside by Rotch for the permanent endowment of the Blue Hill Observatory as a branch of Harvard. Rotch was afterwards appointed Professor of Meteorology in that institution, and took some part in the instruction of occasional advanced students. The work of the observatory included the determination of standard climatic factors, but was more particularly directed to the original investigation of the relation of winds, clouds, precipitation, etc., to passing areas of high and low pressure, and later to the exploration of the upper air by means of kites and balloons, a branch of study in which an unusual measure of success was attained. H. H. Clayton was for some twenty years the first assistant at Blue Hill, and a valued aid in all its work. Recently Rotch gave special attention to the relation of atmospheric conditions to aviation, in which he became a recognized expert. He was an effective member of international meteorological committees, and was slightly esteemed by his colleagues. Rotch was a Fellow and Librarian of the American Academy of Arts and Sciences of Boston, member of the American Philosophical Society of Philadelphia, of the Association of American Geographers.

CORRESPONDENCE.

Mean Sea-level.

With reference to Colonel Burrard's Note on "Mean Sea-level" in the April *Geographical Journal*, I have looked up my original notes, and am sorry to say that I find I dropped a decimal point when I gave the figure of 2 feet for the variation of the annual values of mean sea-level at some of the Indian stations. For this carelessness I must apologize.

The chief object of my original paper was to draw attention to the problem, and point out that our knowledge of the height of mean sea-level round the coasts of Great Britain, and its variations, was very small.

I do not altogether regret my error, as it has resulted in the publication in the *Journal* of the interesting figures given by Colonel Burrard.

E. O. Henrici.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1911-1912.

Tenth Meeting, March 25, 1912.—Colonel Thomas H. Holdich, K.C.M.G., K.C.I.E., C.B., R.E., Vice-President, in the Chair.

Elections.—*F. David Ascoli; J. F. Badham (West African Frontier Force); Paul Borchardt; Rowland Estcourt; Albert Steeds Ford Ford; A. P. Garnier*

(West African Frontier Force); F. W. Henbach; Cecil Boden Klos; Arthur Churchill Matthew; H. K. J. Van der Spuy.

The paper read was:—

"Exploration in North-West Mongolia and Dzungaria." By Douglas Carruthers.

Eleventh Meeting, April 1, 1912. Douglas W. Freshfield, Esq., **Vice-President, in the Chair.**

No Council Meeting having been held on this date, there were no Elections or Proposals.

The paper read was:—

"The Mountains of Northern Sikkim and Garhwal. By Dr. A. M. Kellas.

Captain Scott's Antarctic Expedition.

Mr. Douglas Freshfield (Vice-President), in the chair, said: Before we proceed to the business of the meeting, you may expect some reference to the news in the papers this morning from Captain Scott with reference to the British Antarctic Expedition. You may possibly hope that we have further news to give you to-night; but I am sorry to say I must disappoint that expectation; I have, however, good ground to believe that, within the next twenty-four hours you will receive news through the ordinary channels. Further telegrams from Captain Scott are, we know, on the way to England. Meantime we shall all rejoice to learn that Captain Scott's expedition has so far not met with any serious reverse of any kind, and is still moving forward. We must also feel great satisfaction in the fact that its leader has made the noble resolve to stop in the Antarctic for another year, for in that way only can the full results of this scientifically equipped expedition be gathered for this country. I do not know that I need say more, but on one point, the time at which Captain Scott first received the news of Captain Amundsen's expedition, there is, perhaps, a little confusion in the public mind. The news that Captain Amundsen had determined to make a dash for the South Pole was first sent to England by him when he was on the point of leaving Madeira. It was sent to the subscribers to his proposed Arctic expedition, and was forwarded to Captain Scott, who received the message in New Zealand. But the first news, to use Sir Clements Markham's perfectly accurate words, of "the actual presence of Amundsen in the Antarctic" was obtained by the *Terra Nova*, which brought it back to Captain Scott's winter quarters in the autumn, after he had gone south to fix his depôts.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
Jber. = Jahresbericht.
k.k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. = (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps, Central. *Jb. Schweizer Alpenclub* **46** (1910): 228–250. **Nussbaum.**
Die Tal- und Bergformen des Vispgebietes. Von Dr. F. Nussbaum. *Illustrations.*

Alps, Eastern. *Deutsche Rundschau G.* **34** (1911–12): 9–14. **Krebs.**
Die Waldgrenze in den Ostalpen. Von N. Krebs.

Alps, Eastern—Pasturage. *M. k.k. G. Ges. Wien* **54** (1911): 324–335. **Peintinger.**
Zur Geographie und Statistik der Almen im Hochschwabgebiete. Von Dr. Alfred Peintinger.

Alps, Eastern—Pasturage. **Wallner.**
M. k.k. G. Ges. Wien **54** (1911): 358–403.
Die jährliche Verschiebung der Bevölkerung und der Siedlungsgrenze durch die Almwirtschaft im Lungau. Von Dr. Hans Wallner. *Sketch-maps and Diagrams.*

Austria—Climate. *Sitzb. k. A.W. Wien*, Abt. IIa. **120** (1911): 837–849. **Kielhauser.**
Der tägliche und jährliche Gang der Sonnenscheindauer in Triest. Von Dr. Ernst A. Kielhauser.

Austria—Styria—Alpine Pastures. *M. k.k. G. Ges. Wien* **54** (1911): 305–323. **Sieger.**
Die almstatistische Probeerhebung in der Steiermark. Von Prof. Dr. Robert Sieger.

Denmark—Lakes. **Brönsted and Wesenberg-Lund.**
Internat. Rev. Hydrobiologie, etc. **4** (1911–12): 251–290, 437–492.
Chemisch-physikalische Untersuchungen der dänischen Gewässer, nebst Bemerkungen über ihre Bedeutung für unsere Auffassung der Temporalvariation. Von J. N. Brönsted und C. Wesenberg-Lund. *Diagrams.*

Færoes—Hydrography. **Knudsen.**
Meddelelser Kom. Havundersøgelser, Copenhagen, Hydrografi **2** (1911), Nr. I., pp. 18.
Danish hydrographical investigations at the Faroe Islands in the spring of 1910. By Martin Knudsen. *Charts and Diagrams.*

France—Paris Basin. *B.S. Belge Géol., Mém.* **25** (1911): 3–104. **Mary.**
Le problème de l'eau dans le Nord-Ouest du bassin de Paris. Par Albert et Alexandre Mary. *Sketch-maps, Plans, Illustrations, and Section.*

Germany, Central—Odenwald. *G.M. Hessen* **6** (1911): 1–70. **Jungk.**
Die Ortschaften des Odenwalds nach Lage und Gestalt. Von Dr. A. Jungk. *Maps.*

Germany—Coasts. *Ann. Hydrographie* **39** (1911): 633–641. **Steffens.**
Die Eisverhältnisse an den deutschen Küsten. Nach den achtjährigen Beobachtungen vom Winter 1903–4 bis 1910–11 im dienstlichen Auftrage bearbeitet von Dr. O. Steffens. *Sketch-map and Diagrams.*

See Monthly Record, April, p. 392.

Germany—Historical. *National G. Mag.* **22** (1911): 931–947. **Buxton.**
A corner of Old Württemberg. By B. H. Buxton. *Sketch-map and Illustrations.*

Germany—Mecklenburg. *M.G. Ges. Rostock* **1** (1910): 7–16. **Ule.**
Die Mecklenburgische Schweiz. Von Dr. Willi Ule.

Germany—Mecklenburg—Villages. *M.G. Ges. Rostock* **1** (1910): 17–38. **Tischbein.**
Beitrag zur Rundlingsfrage in Mecklenburg. Von Harry Tischbein.

Germany—Moselle Valley. *Deutsche G. Blätter* **34** (1911): 78–98. **Dietrich.**
Die Siedlungen des Moseltales in ihrer Abhängigkeit von den morphologischen Verhältnissen. Von Dr. Bruno Dietrich. *Sketch-map.*

Germany—Palatinate. **Häberle.**
Ueber Kleinformen der Verwitterung im Hauptbuntsandstein des Pfälzerwaldes. Von Dr. Daniel Häberle. Heidelberg: Carl Winter, 1911. Size 9½ × 6½, pp 166–209. *Illustrations.*

Germany—Prussia. *Deutsche G. Blätter* **34** (1911): 49–79. **Eckert.**
Die wirtschaftliche Abhängigkeit Rheinland-Westfalens vom Boden. Eine wirtschaftsgeographische-heimatkundliche Studie. Von Prof. Dr. Max Eckert.

Germany—Saxony. **Bolle.**
M.V.E. Halle a. S. **33** (1909): 1–71; **34** (1910): 1–73; **35** (1911): 1–50.
Beiträge Zur Siedlungskunde des Havelwinkels. Von Max Bolle. *Maps and Diagrams.*

Germany—Taunus. **Knieriem.**
Die Lage der Siedelungen im Taunus . . . Von Dr. Friedrich Knieriem. Giessen, 1911. Size 9 × 6½, pp. 60. *Maps.*

Germany—Württemberg—Cartography. **Stavenhagen.**
Deuts. Rundschau G. **34** (1911–12): 49–58.
Ueber Württembergs amtliches Kartenwesen. Von W. Stavenhagen.

Greece—Caverns. *Spelunca* **8** (1911): Nos. 63–64, pp. 76. **Sidérides.**
Les Katavothres de Grèce. Par N.-A. Sidérides. *Sketch-map and Sections.*
See note in the Monthly Record, April, p. 393.

Holland—Zuider Zee. *Ann. Hydrographie* **39** (1911): 485–488. **Horn.**
Einfluss der Abschliessung der Zuiderzee auf die Flutgrösse ausserhalb der Abschliessung. Von A. v. Horn. *Sketch-map.*

Iceland. *J.C. Schweizer Alpenclub* **46** (1910): 154–186. **Stoll.**
Quer durch Island. Von Hermann Stoll. *Illustrations.*

Iceland—Place-name. **Spethmann.**
Sandar, Sander, Sandur oder Sandr? Von Dr. Hans Spethmann. (Separat-Abdruck aus den Centralblatt f. Min., etc., Jahrg. 1911, No. 21.) [Stuttgart, 1911.] Size 9 × 6, pp. 673–675.

Italy—Alps—Climate. *Riv. G. Italiana* (1911): 370–381. **Monti.**
Sul clima del Gran Paradiso. Del V. Monti.

Italy—Coast-lines. *Riv. G. Italiana* (1911): 412–416. **Biasutti.**
Variazioni di spiagge, terrazzi e depositi quaternari lungo le coste italiane. Del R. Biasutti.

Norway—Precipitation. **Mohn.**
Nedbør i Norge. Av H. Mohn. (Saertryk av "Naturen," Marts-April, 1911.) [Bergen, 1911.] Size 9 × 6, pp. 114–135. *Sketch-maps and Diagrams.*

Russia—Crimea. *Deuts. Rundschau G.* **33** (1911): 467–472. **Fester.**
Geographische Charakterbilder aus der Krim. Von Dr. G. Fester. *Illustrations.*

Russia—Donetz. **Sokolof and Lutugin.**
Mém. Comité Géologique, N.S., Livr. **53** (1910): pp. 50.
La partie occidentale de l'anticlinal principal du bassin du Donetz (région de Gorlovka). Von V. Sokolov et L. Loutouguine. *Map and Diagrams.* [In Russian; French *résumé*.]
Chiefly concerned with the coal deposits.

Russian Empire—Climate. **Ficker.**
Sitzb. k. A.W. Wien, Abt. IIa. **120** (1911): 745–836.
Das Fortschreiten der Erwärmungen (der "Wärmewellen") in Russland und Nordasien. Von Dr. H. v. Ficker. *Maps and Diagrams.*

ASIA.

China—Chekiang. *B. American G.S.* **43** (1911): 801–826. **Goodchild.**
North-eastern Chehkiang, China: Notes on human adaptation to environment. By Thomas Goodchild. *Sketch-map and Illustrations.*

China—Historical. *T'oung Pao* **12** (1911): 483–543. **Cordier.**
L'arrivée des Portugais en Chine. Par Henri Cordier.

French Indo-China. *B.S.G. Com. Paris* **33** (1911): 697–724. **Legendre.**
Les grands courants commerciaux du Far-West Chinois et notre chemin de fer du Yunnan. Par Dr. Legendre. *Sketch-map.*

India—North-East Frontier. ——
East India (North-East Frontier). Operations against Abors. London: Wyman & Sons, 1911. Size 19 × 8½, pp. iv. and 22.

India—Refraction. **Shaw.**
Survey of India. Professional Paper No. 11. Observations of Atmospheric Refraction, 1905–09. By H. G. Shaw. Dehra Dun, 1911. Size 10½ × 8½, pp. 16. *Diagrams.*

Malay Archipelago—Tides. **Van der Stok.**
Ann. Hydrographie **39** (1911): 227–241, 303–317, 354–373.
Elementare Theorie der Gezeiten nebst den Gezeitenkonstanten der wichtigsten Orte des Indischen Archipels und anderer Hafenplätze. Von Dr. J. P. van der Stok. *Sketch-maps and Diagrams.*

Turkey—Mesopotamia. *M. k.k. G. Ges. Wien* **54** (1911): 409–431. **Tschamler.**
Studie zu Dr. Pietschmanns photogrammetrischen Aufnahmen in Mesopotamien im Jahre 1910. Von Ignaz Tschamler. *Map and Illustrations.*
Reference to Dr. Pietschmann's journey was made in vol. **38**, p 529.

Turkey—Syria. *J. United Service I. India* **40** (1911): 409–415. **Murphy.**
The Turkish expedition into the Hauran. By Captain C. C. R. Murphy. *Map.*

AFRICA.

Belgian Congo—Katanga. *M.G. Ges. Jena* **29** (1911): 85–89. **Fisher.**
Von Lovaleland nach dem Mwerusee. Von Dr. — Fisher.

Egypt—Anthropology. **Craig.**
Anthropometry of modern Egyptians. By J. I. Craig. (From *Biometrika*, vol. **8**, Nos. 1 and 2, July, 1911.) Cambridge, 1911. Size 11 × 7½, pp. 66–78. *Sketch-map and Diagram.*

Egypt—Siwa. **Stanley.**
Egyptian Government. Department of Public Health. A report on the Oasis of Siwa. By Captain C. V. B. Stanley. Cairo, 1911. Size 13½ × 8½, pp. 64. *Sketch-maps and Illustrations. Presented by the Author.*

Egypt—Underground Waters. *Cairo Sc. J.* **5** (1911): 245–261. **Grabham.**
The waters of the Kharga. By G. W. Grabham. *Sketch-map and Sections.*

French West Africa. *B.S.G. Alger* **16** (1911): 119–153. **Labatut.**
Le Territoire Militaire du Tchad. (Kanem, le Lac Tchad, Ouadaï.) Conférence de M. Labatut.

French West Africa *Renseignements Col., Afrique française* (1911): 229–233. **Roucaud.**
Une reconnaissance vers l'Egueï et le Toro. Par le lieutenant Ch. Roucaud. *Sketch-map.*
Noticed in the Monthly Record, February, p. 158.

German East Africa—Boundary. *Deutsches Kolonialblatt* **22** (1911): 613–617. ——
Abkommen, betr. Festlegung der Grenze zwischen Deutsch-Ostafrika und der Belgischen Kongokolonie. *Map.*

German East Africa—Ethnology. **Krause.**
Das Pfeilgift der Watindigas. Von M. Krause. (Sonderabdruck aus der Berliner klin. Wochenschrift, Berlin, 1910, Nr. 37.) Size 8½ × 5½, pp. 8. *Illustrations.*

Gold Coast—Ashanti. *Le Globe, Mém. S.G. Genève* **50** (1911): 59–73. **Ramseyer.**
L'Achanti autrefois et aujourd'hui. Le lac sacré de Bosomtschve. Par F. Ramseyer.

German South-West Africa. **Singelmann.**
Deutsche Kolonialzeitung **28** (1911): 520–522.
Die Expedition nach dem Okavango. Von Konsul Singelmann. *Sketch-map and Illustrations.*

Italian Somaliland. **Baldacci.**
La Somalie italienne. Par A. Baldacci. (From the *Revue Economique Internationale*, vol. 3, No. 3, September, 1911.) Brussels, 1911. Size 9½ × 6½, pp. 514–543.

Morocco—Fez. *B.S.G. Alger* **16** (1911): 182–205. **Schneider.**
Fez. Par M. le Capitaine Schneider. *Map.*

Nigeria. *United Empire* **2** (1911): 612–622. **Dennett.**
Development of native governments in Southern Nigeria. By R. E. Dennett. *Sketch-map and Illustrations.*

Nigeria—Mineral Survey. **Dunstan.**
Northern Nigeria. Reports on the results of the mineral survey, 1907–8 and 1908–9. By Prof. Wyndham R. Dunstan. (Colonial Reports—Miscellaneous, No. 79, 1911.) London, 1911. Size 9½ × 6, pp. 40.

Nigeria—Mineral Survey. **Dunstan.**
Southern Nigeria. Report on the results of the mineral survey, 1908–09. By Prof. Wyndham R. Dunstan. (Colonial Reports—Miscellaneous, No. 81, 1911.) London, 1911. Size 9½ × 6, pp. 36.

Nyasaland—Mineral Survey. **Dunstan.**
Nyasaland. Report on the results of the mineral survey, 1908–09. No. III. of series. By Prof. Wyndham R. Dunstan. (Colonial Reports—Miscellaneous, No. 80, 1911.) London, 1911. Size 9½ × 6, pp. 24.

Portuguese East Africa—Gazaland. **Swynnerton and others.**
J. Linnean S. (*Botany*) **40** (1911): 1–246.
A contribution to our knowledge of the flora of Gazaland: being an account of collections made by C. F. M. Swynnerton, Dr. A. B. Rendle, E. G. Baker, S. Moore, and A. Gepp; with notes by Mr. Swynnerton. *Sketch-map and Illustrations.*

Sahara—Senussi. *B.S.G. Alger* **16** (1911): 68–81. **Labatut.**
De la Confrérie des Senoussya. Par Labatut.

South-West Africa—Walfish bay. **Prida.**
Africa. No. I. (1911). Translation of the Award of Don Joaquin Fernandez Prida, Arbitrator in the matter of the Southern Boundary of the territory of Walfisch Bay. London: Wyman & Sons, 1911. Size 13 × 8½, pp. 34. *Map.*
See note in the January number, 1912, p. 75; also *Deutsches Kolonialblatt* **22** (1911): 802–803.

Sudan—Storms. *La G., B.S.G. Paris* **24** (1911): 233–242. **Hubert.**
Le mécanisme des orages au Soudan. Par Henry Hubert.

Transvaal—Tin. **Kynaston and others.**
Transvaal Mines Department. Geological Survey, Memoir No. 4. The Geology of the Waterberg Tin-fields. By H. Kynaston and E. T. Mellor, with a chapter on their Economic Aspects, by U. P. Swinburne. Pretoria, 1909. Size 10 × 6½, pp. 124. *Maps, Illustrations, Sections, and Diagram.*

Tunis—Ethnology. *National G. Mag.* **22** (1911): 787–846. **Johnson.**
The Mole Men: An account of the Troglodytes of Southern Tunisia. By Frank Edward Johnson. *Illustrations.*

NORTH AMERICA.

Alaska—Coal. *Popular Sc. Monthly* **79** (1911): 417–430. **Kay.**
The Bering River Coal Field, Alaska. By George F. Kay. *Sketch-map and Illustrations.*

Canada—Place-names. ——
Ninth Report of the Geographical Board of Canada for the year ending June 30, 1910. Ottawa, 1911. Size 9½ × 6½, pp. 456. *Maps in separate case.*

Canada—Quebec. *American J. Sc.* **32** (1911): 291–317. **Goldthwait.**
The twenty-foot terrace and sea-cliff of the Lower Saint Lawrence. By James Walter Goldthwait. *Sketch-maps, Illustrations, and Sections.*

Labrador. *Appalachia* **12** (1911): 254–262. **Cabot.**
Labrador and why one goes there. By William B. Cabot. *Illustrations.*

Mexico—Census. *Petermanns M.* **57** (1911) II.: 191–194. **Wittich.**
Die Volkszählung in der Republik Mexiko im Jahre 1910. Von Dr. Ernst Wittich. *Map.*

Mexico—Durango. *Mem. S. Científica "Antonio Alzate"* **29** (1909–10): 5–19. **Rouaix.**
Configuración geográfica y climas del Estado de Durango. Por Pastor Rouaix. *Illustrations.*

Mexico—Geographical Progress. **Rojas.**
B.S. Mexicana G. **4** (1911): 351–358, 365–380, 414–439.
Progreso de la Geografía en México, en el primer siglo de su Independencia. Por Isidro Rojas.

Mexico—Historical. *B.S. Mexicana G.* **4** (1911): 393–406, 454–479, 502–514. **Becerra.**
Itinerario de Hernán Cortés en Tabasco. Por Sr. Prof. D. Marcos E. Becerra.

United States—California. *Monthly Weather Rev.* **38** (1910): 127–129. **Lee.**
Precipitation, run-off, and evaporation in the Owens Valley. By Charles H. Lee.

United States—California. *Monthly Weather Rev.* **39** (1911): 1257–1259. **Matthes.**
The Winds of the Yosemite Valley. By F. E. Matthes. *Illustration and Diagram.*

United States—California—Rainfall. *Monthly Weather Rev.* **39** (1911): 1092–1099. **Lee.**
Precipitation and altitude in the Sierra. By Charles H. Lee. *Diagrams.*
See note in the Monthly Record, February, 1912, p. 159.

United States—California—Snow and Water-supply. **McAdie.**
Monthly Weather Rev. **39** (1911): 445–447.
Forecasting the supply of water for the summer from the depth of snow. By Alexander G. McAdie. *Diagrams.*

United States—Climate. *Monthly Weather Rev.* **39** (1911): 469–470. **Morrow.**
Indian Summer. By Josiah Morrow.
See February number, p. 160.

United States—Delaware. *Papers, Peabody Museum* **5** (1911): pp. xvi. and 258. **Volk.**
The Archæology of the Delaware Valley. By Ernest Volk. *Sketch-maps, Sections, and Illustrations.*

United States—Evaporation. *Monthly Weather Rev.* **38** (1910): 1133–1135. **Bigelow.**
Studies on the phenomena of the evaporation of water over lakes and reservoirs. VII. Summary of the results of the Salton sea campaign. By Prof. Frank H. Bigelow.

United States—Forestry. *B.G.S. Philadelphia* **9** (1911): 163–168. **Graves.**
The problem of Forestry. By Henry S. Graves. *Illustrations.*

United States—Georgia. **Herrmann.**
Monthly Weather Rev. **38** (1910): 1639–1642, 1789–1790.
The water-power resources of Georgia. By C. F. von Herrmann. *Sketch-map and Illustration.*

United States—Meteorology. *B. Mount Weather Observatory* **4** (1911): 25–102. **Blair.**
Summary of the free air data at Mount Weather for the three years, July 1, 1907, to June 30, 1910, also for January, February, and March, 1911. By William R. Blair. *Charts and Diagrams.*

United States—Missouri River. *Monthly Weather Rev.* **39** (1911): 877–879. **Reed.**
Floods of the Upper Missouri River. By C. D. Reed.

United States—New Mexico. **Meinzer.**
U.S. Geol. Surv. Water-Supply Paper **275** (1911): pp. 90.
Geology and water resources of Estancia valley, New Mexico, with notes on ground-water conditions in adjacent parts of central New Mexico. By Oscar E. Meinzer. *Maps, Diagrams, Sections, and Illustrations.*

United States—New Mexico. *American J. Sc.* **32** (1911): 237–245. **Rich.**
Recent stream trenching in the semi-arid Portion of South-western New Mexico, a result of removal of vegetation cover. By John Lyon Rich. *Illustrations.*

United States—New York—Population. **Jefferson.**
B. American G.S. **43** (1911): 737–740.
The Real New York in 1910. By Mark Jefferson. *Sketch-map.*

United States—New York. *J.G.* **10** (1911): 80–86. **Roorbach.**
Geographic influences in the development of the manufacturing industry of the Mohawk Valley. By George B. Roorbach. *Diagram.*

United States—Ohio. **Carney.**
Geographic conditions in the early history of the Ohio country. By Frank Carney. (Reprinted from the *Bulletin of the Scientific Laboratories of Denison University*, vol. **16**, July, 1911.) N.P. 1911. Size 10 × 7, pp. 403–423.

United States—Ohio. **Carney.**
The abandoned shorelines of the Vermilion quadrangle, Ohio. By Frank Carney. (Reprinted from the *Bulletin of the Scientific Laboratories of Denison University*, vol. **16**, 1911.) N.P. 1911. Size 10 × 7, pp. 233–244. *Sketch-map and Sections.*

United States—Ohio—Geology. **Carney.**
The Geologic Development of Ohio. By Frank Carney. (Reprinted from the *Bulletin of the Scientific Laboratories of Denison University*, vol. **16**, 1911.) N.P. 1911. Size 10 × 7, pp. 365–380.

United States—Ohio—Relief. **Carney.**
The relief features of Ohio. By Frank Carney. (Reprinted from the *Bulletin of the Scientific Laboratories of Denison University*, vol. **16**, 1911.) N.P. 1911. Size 10 × 7, pp. 381–402. *Sketch-map.*

United States—Oklahoma—Ethnology. **Speck.**
Univ. Pennsylvania, Anthropol. Publ. **1** (1909): No. 1, pp. 154.
Ethnology of the Yuchi Indians. By Frank G. Speck. *Illustrations.*

United States—Phytogeography. **Harshberger.**
P. American Philosoph. S. **50** (1911): 457–496.
An hydrometric investigation of the influence of sea-water on the distribution of salt-marsh and estuarine plants. By Dr. John W. Harshberger. *Sketch-map and Illustrations.*

United States—Wisconsin. *Monthly Weather Rev.* **38** (1910): 720–723. **Devereaux.**
Relation of deforestation to precipitation and run-off in Wisconsin. By William C. Devereaux. *Diagrams.*

CENTRAL AND SOUTH AMERICA.

Argentine—Buenos Aires. **Cardoso.**
Ann. Museo Nacional, Buenos Aires, Ser. III. **14** (1911): 309–372.
Buenos Aires en 1536. Por Anibal Cardoso. *Sketch-maps, Plans, and Sections.*

Bolivia. **Posnansky.**
Tihuanacu y la Civilización Prehistórica en el Altiplano Andino. Por Arthur Posnansky. La Paz, 1911. Size 8 × 4½, pp. 32.

Brazil. *M.V.E. Leipzig* 1910 (1911): 31–37. **Krause.**
Geographisches und Anthropogeographisches aus Zentralbrasilien. Von Dr. Fritz Krause. *Illustrations.*
Some account of Dr. Krause's journey was given in vol. **38**, p. 627.

Brazil—Coffee Industry. *National G. Mag.* **22** (1911): 908–931. **Ward.**
A visit to the Brazilian Coffee Country. By Robert de C. Ward. *Sketch-map and Illustrations.*

British Guiana. *National G. Mag.* **22** (1911): 859–870. **Eigenmann.**
Notes from a naturalist's experiences in British Guiana. By C. H. Eigenmann. *Illustrations.*

British Guiana—Kaieteur fall. *National G. Mag.* **22** (1911): 846–859. **Kennedy.**
The World's Greatest Waterfall. The Kaieteur Fall, in British Guiana. By Leonard Kennedy. *Sketch-map and Illustrations.*
It will be a matter of opinion whether the epithet is justified.

Chile—Climate. *J. Scottish Met. S.* **15** (1911): 313–346. **Mossman.**
The Climate of Chile. By R. C. Mossman. *Sketch-map.*

Paraguay. *M.G. Ges. Jena* **29** (1911): 1–50. **Carnier.**
Paraguay. Versuch zu einer morphologischen Betrachtung seiner Landschaftsformen. Von Dr. K. Carnier. *Map, Illustrations, and Sections.*

Patagonia. *Deuts. Rundschau G.* **33** (1911): 454–467. **Córdoba.**
Die wirtschaftliche Erschliessung Patagoniens. Von G. L. J. Cordoba.

Peru—Cajamarca. *B.S.G. Lima* **20** (1906): pp. xvi. and 326. **Santolalla.**
Departamento de Cajamarca. Monografia Geografico-Estadistica. Por Fermin Malaga Santolalla. *Map and Illustrations.*

South America—Commerce. *Deutsches G. Blätter* **34** (1911): 106–119. **Beyer.**
Wirtschaftsgeographisches aus Südamerika. Von Prof. Dr. A. Beyer.

South America—Glaciation. **Sievers.**
Die heutige und die frühere Vergletscherung Südamerikas. Von Wilhelm Sievers. (Gesellschaft Deutscher Naturforscher und Ärzte, Sonderabdruck aus den Verhandlungen, 1911.) Leipzig, 1911. Size 9½ × 7, pp. 24. *Maps and Diagrams.*

AUSTRALASIA AND PACIFIC ISLANDS.

Australia—Colonization. **Danes.**
J. and P.R.S. New South Wales **44**, 1910 (1911): 416–419.
Notes on the Suitability of Tropical Australia for the White Races. By Dr. T. V. Danes.

Australia—East Coast—Morphology. **Hedley.**
A Study of Marginal Drainage. Presidential address by C. Hedley. (From the *Proceedings of the Linnean Society of New South Wales*, 1911, vol. **36**, Part I. March 29.) [Sydney], 1911. Size 8½ × 5½, pp. 40. *Sketch-maps and Diagrams.*

Australia—Eastern. **Andrews.**
J. and P.R.S. New South Wales **44**, 1910 (1911): 420–480.
Geographical Unity of Eastern Australia in Late and Post Tertiary Time, with Applications to Biological Problems. By E. C. Andrews. *Sketch-maps.*

Fiji—Rocks. **Cochrane.**
Legislative Council, Fiji. Council Paper, No. 15. Rocks of Fiji. By N. D. Cochrane. Report on the rocks of Vitilevu and Vanualevu. Suva: Edward John March, 1911. Size 13 × 8½, pp. 20. *Maps.*

New Guinea—German. *Petermanns M.* **57** (1911) II.: 187–191. **Pilhofer.**
Eine Reise in das Hinterland von Finschhafen (Kaiser-Wilhelms-Land). Von Missionar G. Pilhofer. *Map and Illustrations.*

New Guinea—German. *Deutsches Kolonialblatt* **22** (1911): 629–635. **Meier.**
Bericht des Architekten Hans Meier über eine von Simbang aus unternommene Inlandexpedition. *Sketch-map.*

New South Wales—Geology. **Benson.**
J. and P.R.S. New South Wales **44**, 1910 (1911): 495–555.
The Volcanic Necks of Hornsby and Dundas, near Sydney. By W. N. Benson. *Sketch-map, Sections, and Diagram.*

New Zealand—Dunes. **Cockayne.**
New Zealand. Department of Lands. Report on the Dune-areas of New Zealand, their Geology, Botany, and Reclamation. By Dr. L. Cockayne. Wellington, 1911. Size 13 × 8½, pp. 76. *Illustrations and Sections.*

New Zealand—Mines. **Strauchon.**
New Zealand. Department of Mines. Report on the survey operations for the year 1910–11. By John Strauchon. Wellington, 1911. Size 13 × 8, pp. 34. *Maps, Plans, Diagrams, and Illustrations.*

Pacific islands. *La G., B.S.G. Paris* **24** (1911): 137–152. **Viala.**
Les îles Wallis et Horn. Par le Dr. M. Viala.

Pacific—Tuamotu Group. *M.V.E. Leipzig*, 1910 (1911): 97–176. **Friederici**
Ein Beitrag zur Kenntnis der Tuamotu-Inseln. Von Dr. Georg Friederici. *Maps and Illustrations.*

Samoa—Savaii. *Z. Ges. E. Berlin* (1911): 485–491. **Grevel.**
Der Matavanú auf Sawaii am 9. April 1911. Von Dr. Wilhelm Grevel. *Illustrations.*
A later account by Dr. Grevel is referred to in the March number, p. 288.

Tasmania—King island. **Debenham.**
J. and P.R.S. New South Wales **44**, 1910 (1911): 560–576.
Notes on the Geology of King Island, Bass Straits. By F. Debenham. *Sketch-map.*

Western Pacific—Historical. *J. Polynesian S.* **20** (1911): 159–161. ——
Enua-manu, the land of birds.
A halting-place of the Rarotongans when migrating. It is probably New Guinea.

POLAR REGIONS.

Arctic—Air-ship Expedition. *Petermanns M.* **57** (1911) II.: 241–246. **Hergesell.**
Unsere geplante Polarfahrt mit Zeppelin-Schiffen. Eine Entgegnung auf Prof. Sievers' Kritische Betrachtung. Von Prof. Dr. H. Hergesell.

Arctic—Air-ship Expedition. *Petermanns M.* **57** (1911) II.: 177–179. **Sievers.**
Die geplante Polarfahrt mit Zeppelinschiffen. Eine kritische Betrachtung. Von Prof. Dr. Wilhelm Sievers. (Schlusswort, pp. 325–326.)

Arctic—Greenland. *M.V.E. Leipzig* 1910 (1911): 15–23. **Stolberg.**
Die Schlittenreise der Deutschen und Schweizerischen Grönlandexpedition 1908–09. Von Dr. A. Stolberg. *Sketch-map and Illustrations.*

Arctic—Peary Expedition. *B.S.G. Italiana* **12** (1911): 1395–1399. **Roncagli.**
La prova della sincerità di Peary fornita dagli stessi suoi documenti. Del Comandante G. Roncagli. *Facsimiles.*

Novaya Zemlya. *Zemleyedenie* **17** (1910): No. 3, 49–57. **Petukhof.**
On the northern island of Novaya Zemlya: a new station. By N. Petukhof. [In Russian.]

Spitsbergen. *La G., B.S.G. Paris* **24** (1911): 249–253. **Hoel.**
La nouvelle expédition norvégienne au Spitsberg. Par Adolf Hoel.
See February number, 1912, p. 260.

MATHEMATICAL GEOGRAPHY.

Cartography—Methods. *M. k.k. Militär-G. Institutes* **30** (1910): 87–93. **Hübl.**
Beiträge zur Technik der Kartenerzeugung. VI. Die Gummidruck-Rotationspresse. Von Generalmajor Artur Freiherrn von Hübl.

Photographic Surveying. *M. k.k. Militär-G. Institutes* **30** (1910): 62–86. **Orel.**
Der Stereoautograph als Mittel zur automatischen Verwertung von Komparatordaten. Von Eduard Ritter von Orel. *Illustrations and Diagrams.*

Position-fixing. *Nautical Mag.* **86** (1911): 489–494. **Sword.**
An idea on position-finding at sea by means of measured electrical waves. By M. E. Sword. *Diagram.*

Position-fixing. *B. American G.S.* **43** (1911): 767–770. **Ault.**
Daylight observations on Venus. By J. P. Ault.
On the possibility of such observations for the determination of position.

Surveying. *D. Reimer's M. für Ansiedler u.s.w.* **5** (1911): 51–76. **Böhler.**
Praktische Winke für Vermessungs- und Kulturtechnik in den Tropen. Von H. Böhler. *Illustrations and Diagrams.*

Surveying—Azimuths. *Ann. Hydrographie* **39** (1911): 665–668. **Kohlschütter.**
Höhenazimut-Rechenstab. Von Dr. E. Kohlschütter.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Climatology. *G.Z.* **17** (1911): 378–386. **Eckardt.**
Die Veränderungen des Klimas seit dem Maximum der letzten Eiszeit. Von Wilh. R. Eckardt.

Climatology—Cities. *Monthly Weather Rev.* **39** (1911): 1284–1286. **Palmer.**
Is the heat generated by great cities changing their climates? By Andrew Palmer.
Preceded by another paper on the same subject, by G. W. Mindling (see next page).

Coast-Erosion. *P.I. Civil Engineers* **185** (1910–11): 92–152. **Douglass.**
Coast-Erosion. By William Tregarthen Douglass. *Sections and Illustrations.*

Geology—Laterite. *Geol. Mag.* V. **8** (1911): 454–462, 507–516, 559–566. **Fermor.**
What is Laterite? By Dr. L. Leigh Fermor.

Geomorphology. *Deutsche Rundschau G.* **33** (1911): 472–475. **Krebs.**
Das Erdbild in Mondentfernung. Von Wilhelm Krebs. *Illustrations and Diagram.*

Geomorphology. *Z. Ges. E. Berlin*, 1911: 479–485. **Rühl.**
Isostasie und Peneplain. Von Dr. Alfred Rühl.

Geomorphology—Detritus. *Petermanns M.* **57** (1911) II.: 262–264. **Tarnuzzer.**
Die Schuttfacetten der Alpen und des hohen Nordens. Von Prof. Dr. Chr. Tarnuzzer. *Illustrations.*

Geomorphology—Dunes. *Deuts. Rundschau G.* **33** (1911): 449–453. **Stavenhagen.**
Ueber Stranddünen und ihre Befestigung. Von W. Stavenhagen.

Geomorphology—Dunes. *La G., B.S.G. Paris* **24** (1911): 153–160. **Chudeau.**
Remarques sur les dunes, à propos d'une étude de M. H. J. Llewellyn Beadnell. Par R. Chudeau.

Geomorphology—Hanging valley. *B.G.S. Philadelphia* **9** (1911): 202–209. **Mansfield.**
An unusual type of lateral hanging valley. By George R. Mansfield. *Illustrations and Sections.*

After discussing hanging valleys in general, the author describes forms met with in South-Eastern Idaho.

Geomorphology—Weathering. **Häberle.**
Ueber die Messbarkeit der Fortschritte der Verwitterung. Von Daniel Häberle. (Sonderabdruck aus den Jahresberichten und Mitteilungen des Oberrheinischen Geologischen Vereines, N.F. Bd. I., Heft 2.) Karlsruhe, 1911. Size 8½ × 5½, pp. 53–54.

Geophysics. *Sitzb. K.A.W. Wien*, IIa Abt. **120** (1911): 175–180. **Trabert.**
Eine mögliche Ursache der Vertiefung der Meere. Von Prof. Wilh. Trabert. *Diagrams.*

The suggested cause is the more rapid shrinking of the crust under the ocean, owing to the greater loss of heat by reason of the abruptness of the gradient.

Geophysics. **Love.**
Some problems of geodynamics; being an Essay to which the Adams Prize in the University of Cambridge was adjudged in 1911. By Dr. A. E. H. Love. Cambridge: University Press, 1911. Size 11 × 7, pp. xxviii. and 180. *Price* 12*s. net. Presented by the Publishers.*

Hydrology. *Deutsche G. Blätter* **34** (1911): 99–105. **Halbfass.**
Der Wasservorrat unserer Erde. Von Prof. Dr. W. Halbfass.

Limnology. *G.Z.* **17** (1911): 462–467. **Halbfass.**
Die Lebensgeschichte eines Strandsees. Von W. Halbfass.

Limnology. *Internat. Rev. Hydrobiologie, etc.* **4** (1911): 300–310. **Murray.**
The annual history of a periodic pond. By James Murray.

Meteorology—Evaporation. *Petermanns M.* **57** (1911) II.: 202–203. **Lütgens.**
Die Grösse der Verdunstung auf dem Meer nach experimentellen Untersuchungen auf See. Von Dr. R. Lütgens.

Seismology. *K.A. Wetens., Amsterdam, P. Section Sc.* **13** (1910–11): 11–16. **Braak.**
On the determination of the epicentre of earthquakes by means of records at a single station. By Dr. C. Braak. *Diagrams.*

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Anthropogeography—Cities. *Monthly Weather Rev.* **39** (1911): 1280–1283. **Mindling.**
Influence of artificial heating on the climate of cities. By George W. Mindling. *Diagrams.*

A second paper on the same subject is contributed by A. Palmer (see p. 512).

Censuses. *M.V.E. Leipzig*, 1910 (1911): 476–490.

Die neuen Volkszählungen mit besonderer Berücksichtigung Österreichs.

Commercial—Canals. **Corthell.**

Dimensions to be given to Maritime Canals, taking into account the probable dimensions of ocean ships of the future. Report by Dr. Elmer L. Corthell. (Read at the Twelfth International Congress of Navigation, Philadelphia, 1212, 2nd Section: Ocean navigation, 2nd Question.) Brussels, [1911]. Size 9½ × 6½, pp. 26. *Diagrams.*

Commercial—Communications. *Deuts. Rundschau G.* **34** (1911–12): 66–81. **Rudolphi.**

Trageplätze und Schleppwege (Portagen). Von Dr. Hans Rudolphi. *Map and Illustrations.*

BIOGRAPHY.

Chinese Empire—Manchuria. **Costain.**

The life of Dr. Arthur Jackson of Manchuria. By the Rev. Alfred J. Costain. London: Hodder & Stoughton, (1911). Size 8½ × 5½, pp. 188. *Portrait and Illustrations. Price 2s. net. Presented by the Publishers.*

Reiss. *M.V.E. Leipzig* 1910 (1911): 47–96. **Meyer.**

Wilhelm Reiss. Von Hans Meyer. *Portraits.*

This well-known scientific explorer of the Andes died in 1908 (*Journal*, vol. **32**, p. 630).

GENERAL.

Geography. **Giannitrapani.**

Capt^no^ Luigi Giannitrapani. Geografia generale (fisica, biologica, antropica). Florence: R. Bemporad e Figlio, 1912 [1911]. Size 8½ × 5½, pp. xxviii. and 368. *Sketch-maps, Illustration, and Diagrams. Price 5 lire. Presented by the Author.*

Geography. *Deutsche Rundschau G.* **34** (1911–12): 14–20. **Sawicki.**

Das entwicklungsgeschichtliche Element in der Geographie. Von R. v. Sawicki.

Geography. *Scottish G. Mag.* **27** (1911): 561–573. **Chisholm.**

Some recent contributions to geography. By Geo. G. Chisholm. *Illustrations.*

German Colonies. *G.Z.* **17** (1911): 361–378. **Uhlig.**

Entwicklung, Methoden und Probleme der Geographie der deutschen Kolonien. Von Carl Uhlig.

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

British Isles—England and Wales. **Ordnance Survey.**

Sheets published by the Director-General of the Ordnance Survey, Southampton, from March 1 to 31, 1912.

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(*E. Stanford, London Agent.*)

British Isles—Scotland. **Johnston.**

Bathy-orographical map of Scotland. Scale 1 : 380,000 or 1 inch to 6 stat. miles. Constructed and engraved by W. & A. K. Johnston, Ltd., Edinburgh and London, 1912. *Price, mounted on rollers and varnished,* 12*s. Presented by the Publishers.*

This is one of Messrs. W. & A. K. Johnston's series of wall maps. It shows relief on the layer system in green and reddish-brown, the contours in feet being as follows: 200, 400, 600, 800, 1200, 2000, 3000. Depths of water are given in shades of blue at 100, 200, 300, 400, and 600 feet intervals. Railways are shown in red. The map is mounted on rollers and varnished.

France. **Mechlin.**

Carte Mechlin. France en 47 Feuilles. Scale 1 : 200,000 or 1 inch to 3·2 stat. miles. Sheets: 10, Évreux; 11, Paris-Chalons; 16, Troyes; 17, Épinal; 20, Gien-Auxerre; 21, Dijon-Besançon; 24, Nevers-Chalon; 28, Clermont-Lyon. Paris: Ch. Delagrave, [1912]. *Price* 1 *fr. each sheet.*

France. **Ministre de l'Intérieur, Paris.**

Carte de la France dressée par ordre du Ministre de l'Intérieur. Scale 1 : 100,000 or 1 inch to 1·6 stat. miles. Sheets: VII.–19, St. Nazaire; XIV.–29, Sarlat; XV.–6, Boulogne; XVI.–16, Pithiviers; XVI.–30, Figeac; XXV.–27, St. Jean de Maurienne; XXX.–39, Corte. Paris: Hachette et Cie., 1911. *Price* 0.80 *fr. each sheet.*

France. **Service Géographique de l'Armée, Paris.**

Carte de France. Scale 1 : 50,000 or 1·3 inches to 1 stat. mile. Sheets: XXXVI.–15, Bertrambois; XXXVI.–18, Gérardmer; XXXVI.–19, Bussang. Paris: Service Géographique de l'Armée, 1911. *Price* 1.60 *fr. each sheet.*

Rumania. **Socec.**

Planul orașului Bucuresti dupa ultimele date oficiale. Lucrat in Atelierele Socec & Co., Bucuresti. Scale 1 : 10,700 or 5·9 inches to 1 stat. mile. Bukarest: Socec & Co., 1911.

Turkey. **Ganke.**

Die Befestigung des westlichen Dardanellen-Eingangs. Nach Angaben von Generalmajor z. D. A. Janke. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. *Petermanns Mitteilungen.* Jahrgang 1912, I., Tafel 35. Gotha: Justus Perthes, 1912. *Presented by the Publisher.*

ASIA.

China. **Langhans.**

Karte vom Schauplatz der Chinesischen Revolution bearbeitet von Prof. Paul Langhans. Scale 1 : 5,000,000 or 1 inch to 78·9 stat. miles. Gotha: Justus Perthes, 1911. *Price* 1 *Mark.*

A map based upon sheets in Stieler's Atlas, specially coloured and prepared to illustrate the revolution in China.

India. **Surveyor-General of India.**

Maps published by the Survey of India during the quarter ending December 31, 1911. India and adjacent countries, scale 1 : 1,000,000, 2 sheets.—Degree sheets, scale 1 inch to 4 miles; Bengal, 1 sheet; Bengal and Eastern Bengal and Assam, 1 sheet; Burma, 1 sheet; Eastern Bengal and Assam, 2 sheets.—Standard maps, scale 1 inch to 1 mile: Bengal, 4 sheets; Bengal and Eastern Bengal and Assam, 2 sheets; Berar, 1 sheet; Berar and Bombay, 1 sheet; Berar, Bombay, and Hyderabad, 1 sheet; Bombay, 2 sheets; Bombay, Central India, and Central Provinces, 1 sheet; Bombay and Hyderabad, 3 sheets; Burma, 6 sheets; Central India and Central Provinces, 5 sheets; Central India and United Provinces, 1 sheet; Central Provinces, 5 sheets; Eastern Bengal and Assam, 1 sheet; Hyderabad, 2 sheets; Kashmir and Jammu, 3 sheets; Punjab, 33 sheets; Punjab and Kashmir and Jammu, 5 sheets; Punjab and North-West Frontier Province, 2 sheets; United Provinces, 3 sheets; United Provinces and Central India, 3 sheets. Calcutta: Map Record and Issue Office, 1912. *Presented by the Surveyor-General of India.*

AFRICA.

Africa. **Survey Office, Khartum.**

Africa. Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. Anglo-Egyptian Sudan. Sheets: 55–J, Abba Island; 77–K, Tembura; 77–L, Bangbi; 77–O, Yambio; 77–P, Meridi; 78–I, Lorella; 78–M, Yei; 86–A, Mount Wati. Khartum: Survey Office, 1912. *Price* 10 *P.T. each sheet. Presented by the Director of Surveys, Sudan Government, Khartum.*

Tunis. **Direction Générale des Travaux Publics.**

Carte des Routes et des Chemins de Fer de la Tunisie au 1er Mai 1910 dressée par la Direction Générale des Travaux Publics. Scale 1 : 500,000 or 1 inch to 7·8 stat. miles. Paris: Erhard Frères; Tunis: J. Picard & Cie. 1910.

Gives railways and roads, existing and proposed, paths, lights round the coast, and other information specially connected with means of communication.

Tunis. **Vanney.**

Carte Géologique de la Tunisie. Dressée et dessinée par J. Vanney. Scale: 1 : 500,000 or 1 inch to 7·8 stat. miles. Tunis: C. Saliba Aîné, [1912].

AMERICA.

Brazil. **Commissão Geografica e Geologica do Estado de S. Paulo.**

Estado de S. Paulo, Brazil. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. Sheets: Mococa; S. Sebastião do Paraizo. S. Paulo: Commissão Geographica e Geologica do Estado de S. Paulo, 1911. *Presented by the Commissão Geographica e Geologica do Estado de S. Paulo.*

Brazil. **Freire.**

Republica dos Estados Unidos do Brazil. Mappa organisado e desenhado por Olavo Freire. Scale 1 : 4,000,000 or 1 inch to 63·1 stat. miles. Two sheets. Rio de Janeiro: Francisco Alves & Cia., [1912].

Canada. **Dept. of Militia and Defence, Ottawa.**

Topographic Map of Canada. Scale 1 : 63,360 or 1 inch to 1 stat. mile. Sheets: 29, Long Point; 31, Port Burwell. Published by the Geographical Section, General Staff, War Office. London: E. Stanford, Sifton Praed, and T. Fisher Unwin, [1912]. *Price 2s. net each sheet. Presented by the Director of Military Operations.*

Canada. **Department of the Interior, Ottawa.**

Cereal Map of Saskatchewan showing acreage under crop in each township in wheat, oats, barley, and flax, 1910. Scale 1 : 792,000 or 1 inch to 12·5 stat. miles. Second edition. Ottawa: Dept. of the Interior, Railway Lands Branch, 1910. *Presented by the Department of the Interior, Railway Lands Branch, Ottawa.*

United States. **Rand, McNally & Co.**

The Rand-McNally indexed county and railroad pocket map and shippers' guide of Georgia. Scale 1 : 950,400 or 1 inch to 15 stat. miles. Chicago and New York: Rand, McNally & Co., 1911.

Venezuela. **Razetti.**

Caracas. Plano en escala 1 : 8000 (7·9 inches to 1 stat. mile). Por R. Razetti. [N.P.], 1911.

A rough black-and-white production reduced by photography from a plan on a larger scale, with the result that many of the names are almost illegible.

AUSTRALIA.

Western Australia. **Talbot.**

Topographical map of Mukatharra. By H. W. B. Talbot. Scale 1 : 31,680 or 2 inches to 1 stat. mile. Perth: Geological Survey of Western Australia, 1911. *Presented by the Geological Survey of Western Australia.*

GENERAL.

World. **Debes.**

E. Debes' Neuer Handatlas über alle Teile der Erde in 65 Haupt- und über 130 Nebenkarten mit alphabetischen Namenverzeichnis. 4. stark vermehrte und verbesserte Auflage. Lieferungen 8, 9, 10. Leipzig: H. Wagner & E. Debes, 1911. *Price* 1*M. each part.*

The following are the contents of these parts: Lieferung 8; No. 20, Ost-Deutschland, 25 Alpenländer, Östl. Teil. Lieferung 9; No. 17 Nordost-Deutschland, 12*b*

Europa, politische u. Verkehrs-Uebersicht. Lieferung 10: No. 2–5, Klimakarten der Erde, 39 Nord-Asien.

World. **Fischer.**

Einheitsatlas. Herausgegeben von Prof. Heinrich Fischer. 81 Haupt- und 52 Nebenkarten auf 57 Kartenseiten nebst einer Heimatkarte. Dritte, verbesserte und vermehrte Auflage des "Schulatlas für Anfangsunterricht und Mittelstufen." Bielefeld and Leipzig: Velhagen & Klasing, 1912. *Price* 2*M*. *Presented by the Publishers.*

The third edition of a well-arranged and carefully prepared atlas for German schools, composed of a selection of maps similar to many of those given in the three parts of the Stufenatlas mentioned below. There are altogether 81 principal maps, 52 smaller ones, and 57 insets and plans.

World. **Fischer and Geistbeck.**

Stufenatlas für höhere Lehranstalten, herausgegeben von Prof. H. Fischer und Dr. M. Geistbeck. In drei Stufen. I. Unterstufe, *price* 1 *M*. 30 *Pfg*. II. Mittelstufe, *price* 2 *M*. 20 *Pfg*. III. Oberstufe, *price* 5 *M*. 50 *Pfg*. Bielefeld and Leipzig: Velhagen & Klasing, 1912. *Presented by the Publishers.*

A set of school atlases for higher educational establishments in Germany, arranged in three stages to meet the requirements of younger scholars, those who have made some progress with geographical studies, and those most advanced. Prominence is naturally given to Germany and Central Europe, but all parts of the world are represented. Most of the maps are orographically coloured, and as a rule bring out the leading features of the relief clearly and well. There are numerous insets of town plans, small general maps of the World showing distribution of natural phenomena, astronomical diagrams, commercial maps, types of land forms, etc., all of which are instructive.

World. **Meyer.**

Meyers Geographischer Handatlas. Vierte, neubearbeitete und vermehrte Auflage. Mit 121 Haupt- und 128 Nebenkarten, 5 Textbeilagen und alphabetischen Register aller auf den Karten und Plänen vorkommenden Namen. Leipzig and Vienna: Bibliographisches Institut, 1912. *Price* 15 *M*.

The fourth edition of this useful general atlas contains ten new maps, in most cases drawn on larger scales than those in the earlier editions which they replace. Numerous inset plans with cities and towns have been added, and the index increased by 15,000 place-names, so that it now contains about 103,000 entries altogether. The atlas is convenient in size, measuring only 10¼ inches by 7½ inches, and the 121 maps of which it is composed are full of detailed information, but the names are necessarily very small, and a glass is required to read them on many of the maps.

World. **Service Géographique de l'Armée, Paris.**

Carte de la Terre au 1,000,000e (1 inch to 15·8 stat. miles). (Europe) Nord M 31, Paris. Paris: Service Géographique de l'Armée, 1912. *Price* 1.60 *fr. each sheet.*

This is the first French sheet to be published of the International Map of the World, on the scale of 1 : 1,000,000. It extends in latitude from 48° to 52° N. and in longitude from 0° to 6° E., the area thus embraces Paris and North-East France; but it goes beyond the French boundary, and includes Brussels, Antwerp, Rotterdam, and South-East England. The sheet is orographically tinted in accordance with the system arranged at the International Committee held in London in November, 1909, and is a most creditable production.

World. **Young and Fairgrieve.**

Philips' Contour Exercise Book. By Ernest Young, B.SC., and G. Fairgrieve, M.A. London: George Philip & Son, Ltd., [1912]. *Price* 4*d*. *Presented by the Publishers.*

Contains twenty-six exercises, in black and white, in contouring and drawing vertical sections from contoured plans. The book aims at giving in a few pages a course of exercises sufficiently full and complete for the use of most scholars in secondary schools, and it will also be found useful for all beginning a study of topographical forms and relief. The examples have in several cases been taken from examination papers.

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, from March 3 to 30, 1912. *Presented by the Hydrographer, Admiralty.*

New Charts—No. 618, Scotland, west coast: Loch Boisdale, 2*s*.—**New Editions.**—2255, England, south coast: Weymouth and Portland, 3*s*. 2268, England, south coast: Portland harbour, Portland coaling piers, 3*s*. 1630, England, east coast: Orford ness to Blakeney, with the off-lying shoals between Smith's knoll and the Outer Dowsing, 4*s*. 2397*a*, Scotland, north and east coasts, with the Orkneys and Shetland: south sheet. (Plans: Loch Fleet. Cromarty and Inverness firths, Banff and Macduff, River Tay, Leith and Granton, Head of the Firth of Forth, Fraserburgh, Peterhead, Aberdeen, Montrose, Stonehaven, Arbroath), 3*s*. 1823, Scotland, east coast: Banff to Dunbeath harbour (Plans: Dunbeath harbour, Port Knockie), 3*s*. 1753, Ireland, east coast: Belfast lough, 3*s*. 1245, Ireland, north coast: Horne head to Rathlin O'Birne, 2*s*. 2697, Ireland, north coast: Lough Swilly, 5*s*. 2046, Ireland, south coast: Waterford harbour (Plan: New Ross), 3*s*. 2182*a*, The North sea, southern sheet, 4*s*. 1755, Spain, north-west coast: San Ciprian bay to Cape Finisterre, 3*s*. 1053, Spain, north and west coasts: Cape Peñas to Pontevedra bay. (Plan: Camariñas bay), 3*s*. 1554, Mediterranean: Talanta channel and the western part of the Euripo channel, 2*s*. 243, Mediterranean: Port of Alexandria, 3*s*. 1159, Mediterranean: Susa to Mahedia, with the Kuriat islands (Plans: Anchorage of Monastir, Anchorages of Mahedia), 2*s*. 303, Newfoundland: Miquelon islands (Plans: Miquelon road, St. Pierre harbour), 2*s*. 6*d*. 2561, Bay of Fundy: Gulliver hole to St. Croix bay, 3*s*. 268, United States, east coast: Cape Fear to Sapelo sound, 3*s*. 478, West Indies, Puerto Rico: Port San Juan, 2*s*. 1340, Plans on the coast of Peru: Ylo road, Islay bay, Atico road, Lomas road, Ports of San Nicolas and San Juan, Independencia bay, 2*s*. 674, Africa, east coast: Dar es Salaam and adjoining anchorages, Dar es Salaam harbour, 3*s*. 6*b*, Gulf of Aden, sheet 2: western portion, 3*s*. 1968, China sea: Formosa island and strait, 3*s*. 1798, China, north coast: Kinchau to Terminal head, including Kwang tung peninsula, 4*s*. 1254, Australia, east coast: Port Dungeness, south entrance to Hinchinbrook channel, 2*s*.

(*J. D. Potter, Agent.*)

Atlantic, North. **U.S. Hydrographic Office.**

Pilot chart of the North Atlantic Ocean, March, 1912. Washington: U.S. Hydrographic Office, 1912. *Presented by the U.S. Hydrographic Office.*

Atlantic, North. **U.S. Weather Bureau.**

Meteorological chart of the North Atlantic Ocean, April, 1912. Washington: Department of Agriculture, U.S. Weather Bureau, 1912. *Presented by the U.S. Weather Bureau.*

Atlantic, North, and Mediterranean. **Meteorological Office.**

Monthly Meteorological charts of the North Atlantic and Mediterranean, April, 1912. London: Meteorological Office, 1912. *Price 6d. each. Presented by the Meteorological Office.*

Indian Ocean. **Meteorological Office.**

Monthly Meteorological charts of the Indian Ocean, April, 1912. London: Meteorological Office, 1912. *Price 6d. each. Presented by the Meteorological Office.*

Indian Ocean. **U.S. Hydrographic Office.**

Pilot chart of the Indian Ocean, May, 1912. Washington: U.S. Hydrographic Office, 1912. *Presented by the U.S. Hydrographic Office.*

Indian Ocean. **U.S. Weather Bureau.**

Meteorological chart of the Indian Ocean, March and April, 1912. Washington: Department of Agriculture, U.S. Weather Bureau, 1912. *Presented by the U.S. Weather Bureau.*

North America. **U.S. Weather Bureau.**

Meteorological chart of the Great Lakes, March and April, 1912. Washington: Department of Agriculture, U.S. Weather Bureau, 1912. *Presented by the U.S. Weather Bureau.*

Pacific, North. **U.S. Hydrographic Office.**

Pilot chart of the North Pacific Ocean, May, 1912. Washington: U.S. Hydrographic Office, 1912. *Presented by the U.S. Hydrographic Office.*

Pacific, North. **U.S. Weather Bureau.**

Meteorological chart of the North Pacific Ocean, April, 1912. Washington: Department of Agriculture, U.S. Weather Bureau, 1912. *Presented by the U.S. Weather Bureau.*

PHOTOGRAPHS.

Canary Islands. **Methley.**

Two photographs of the Troglodyte village of Atalaya, Gran Canary, taken by Noël I. Methley, Esq., in 1910. *Presented by Noël I. Methley, Esq.*

(1) General view of the village of Atalaya; (2) A typical cave in the village of Atalaya.

East Indies and Pacific Ocean. **Smith.**

One hundred and twelve photographs of the East Indies, New Guinea, and the Society islands, taken by Harrison W. Smith, Esq. *Presented by Harrison W. Smith, Esq.*

An interesting and exceptionally good set of photographs representative of the scenery, natives, vegetation, etc., of these islands. They measure 3¾ inches by 4¾ inches.

Bali: (1) Chinese junk; (2) Deck hand S.S. *Van Reemsdyk*; (3 and 4) Native children.—**Banda**: (5) Mount Api; (6) In the nutmeg groves.—**Amboina**; (7) Amboina; (8) Bat in the market, Amboina.—**Ceram**: (9–11) Natives at Wahai.—**Java**: (12) Chinese quarter, Batavia; (13) Chinese peddler, Batavia; (14) Chinese paper-toy shop, Batavia; (15) Chinese Merchants, Batavia; (16) Malay women washing clothes, Batavia; (17) Street watering boy, Batavia; (18) Malay boy, Batavia; (19) Native children at Jokjakarta; (20) Natives at Jokjakarta; (21) Canary Avenue, Buitenzorg; (22–24) Botanical gardens, Buitenzorg; (25) Rice harvest, Buitenzorg; (26) Surabaya harbour; (27) Native boys, Surabaya; (28) Chinese juggler, Surabaya; (29) Cargo boat in canal at Surabaya; (30 and 31) Bandung; (32) Native children, Bandung; (33) Mount Ringgit; (34) Mount Chikorai; (35) Garut; (36) Baros bridge, Sukabumi; (37) View from the top of Boro Budur; (38) On the trail up Mount Tangkubanprahu.—**Lombok**: (39–42) Natives of Lombok; (43) Loading cattle; (44) House; (45) Native house; (46) Road building; (47) Rice mortar; (48) Native house; (49) Boats crossing the surf.—**Celebes**: (50 and 51) Native child, Makassar; (52) House built for the Sultan of Goa, Makassar; (53) Bamboo house, Makassar; (54) Boats, Makassar; (55) Irrigating pump, Makassar; (56) Native house, Makassar; (57) Telor river, Makassar; (58 and 59) Natives at Makassar; (60) Boy with bird on fancifully decorated perch.—**Sumbawa**: (61) Sumbawa.—**Buton**: (62) Parrots at Buton.—**Bouro**: (63) Tifu.—**Saparua**: (64–66) Natives of Saparua; (67) On board Dutch coasting steamer; (68) On board Australian ship, Sydney to Java; (69) Dolphin jumping from bow wave off the Queensland coast; (70) Thursday island, Torres strait.—**Dutch New Guinea**: (71) New Guinea prau, Fakfak; (72) Fakfak; (73) New Guinea house, Fakfak; (74) Convicts at Fakfak; (75) New Guinea boats, Fakfak; (77) Malay dug-out at Fakfak; (78–80) Natives at Fakfak; (81) Sunset at the new settlement of Kaymana.—**Society Islands**: (82–84) Views of Tahiti; (85) Harbour of Papiete, Tahiti; (86) Sunset, Tahiti; (87) Native house, Tahiti; (88) Vaihiria valley, Tahiti; (89) Vaihiria lake, Tahiti; (90–93) Coral under water, Tahiti; (94) Wild taro plant, Tahiti; (95) Taetira valley, Tahiti; (96) Bay adjoining Point Venus, Tahiti; (97) The Diadème, Tahiti; (98) Fatanua valley, Tahiti; (99) Fatanua falls, Tahiti; (101–103) Natives of Tahiti; (104–108) Views of Murea; (109) A Murean man; (110) Girls at Murea; (111–112) Picking up fruit, Cook island.

Papua. **Mackay and Little.**

One hundred and nine photographs of Central Papua, taken by Messrs. D. Mackay and W. S. Little, 1908–1909. *Presented by D. Mackay, Esq.*

The journey during which these photographs were taken was described in the *Geographical Journal* for November, 1911, where reproductions of some of them will be found. They are of special interest as a great part of the journey passed through an entirely unexplored region.

(1) Path, Samarai; (2) Police hut thatched with palm leaves; (3) Coral paved path, Samarai; (4) Native police hut; (5) Samarai prison and prisoners; (6) Native dwelling; (7) Palm tree, Samarai; (8) Native police and wives; (9) Dobu (temple), Mr. Mackay and party in foreground; (10) Government station, Kerema; (11) Native police, Kerema; (12 and 18) Kerema natives; (13) Four belles of Kerema; (14) Torapi natives; (15) Dobus at Orokolo village; (16) Lau village children; (17) Embarkation, Alele creek; (19) Beginning of village fire, Maipua; (20) Village fire, Maipua; (21) Interior of Dobu, Toripi; (22) Government rest-house, Maipua; (23) Village of Orikabe; (24) Delta canoe, Purai river; (25) Banyan tree, upper Beroie; (26) Amabeta, one of my cooks; (27) Two cooks, Peter and Amabeta; (28) First wild pig shot by Mr. Bishop, upper Purari; (29) Canoes strapped together ready for Mr. Bell's return to coast; (30) Mr. Bell bids us good-bye; (31) Beroie natives visiting our camp; (32) Delta canoe, Purari river; (33) Mist resting on Mount Musgrave, upper Purari; (34)

Limit of navigation on Purari river, Hathor gorge; (35) Camp on upper Purari; (36) Gai-iro's grave; (37) Fish trap, Anthala river; (39) Washing sago pith; (40) The day's work done, drying sago; (41) Making sago; (42) My boys making sago; (43) Native house near Udi river; (44) Main house of first large village visited west of Purari divide; (45) Native house near Anthala river; (46) Substantial type of native house; (47) Colossal native house, 130 feet long; (48) Small native house near the Styx river; (49) Five specimens of wall drawings by natives; (50) Mr. Pratt taking observations from our furthest west permanent camp; (51) View near source of Purari river; (52) View from top of Southern Range looking towards the coast; (53–57) Views of country west of the Purari divide; (58) Patch of sago palms; (59) Type of my single carriers with load; (60) Type of my double carriers with load; (61 and 62) Types of my carriers representing five different tribes; (63) Upper Beroie natives; (64) Type of cannibal, Styx river; (65) Type of cannibal, Udi river; (66) Udi natives expressing gratification after receiving present of tomahawk; (67 and 68) Samia natives; (69–72) Types of natives west of the Purari divide; (73) Piau river omerging from mountains; (74) Native village out west; (75) Canoes made for return trip; (76) Canoes 35 feet long ready for decking to be put on; (77) Making canoes on Thukuri river; (78) Starting homeward, leaving Thukuri river; (79) Canoes being tested on upper Purari; (80) Canoe being swirled round by the current; (81) Purari river, Bevan island in the distance; (82) Chalmers island, Purari river; (83) Upper Purari; (84) Purari near Aure junction; (85) Canoes being dismantled, Alele creek; (86) Abandoning canoes, Alele creek; (87) My fly, furthest west camp; (89) Native shelter, upper Purari; (90) Native stockade, entrance to village, Udi river; (91) Carriers arriving at village; (92) Camp on upper Purari; (93) Camp on tributary of upper Purari; (94) Our Christmas turkey, a cassowary; (95) Upper Purari, Mount Favenc in distance; (96) Government rest-house, Gulf of Papua; (97) View of the Samia river; (98) Seam of coal near head of Purari river; (99) An upper Purari necklet; (100–102) Talons of a large bird used to make earrings; (103) Child's spinning top and lime pot, upper Purari; (104) Human foot dried and smoked, worn as a neck ornament by natives of the upper Purari; (105) Necklace with charms, worn by natives of the upper Purari; (106) Ornaments worn by natives of the upper Purari; (107) Dried and smoked human hands, upper Purari; (108) Large earrings made from cassowary feathers and necklaces made with seeds; (109) Land shells, upper Purari.

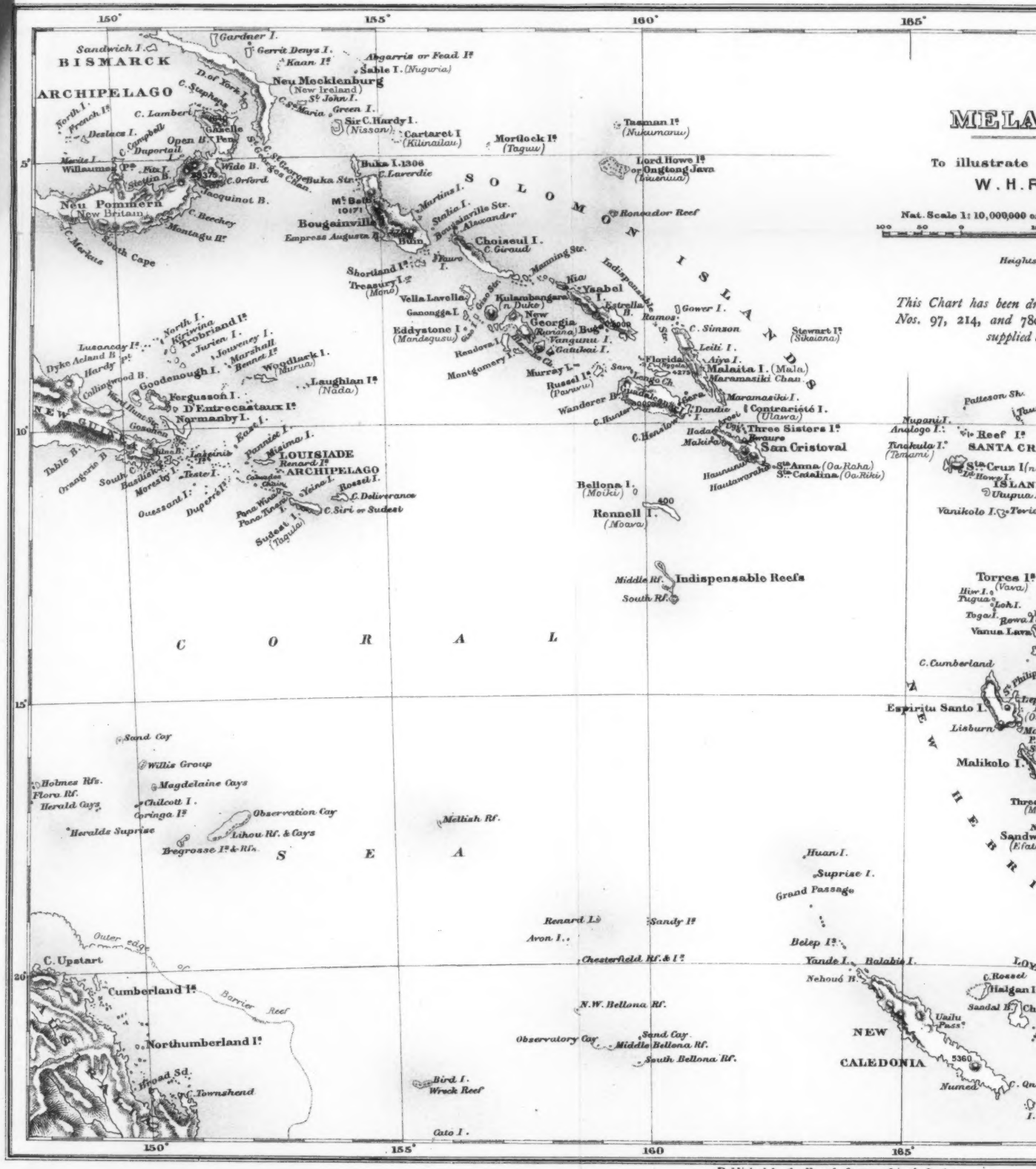
Western Asia. **Watts.**

Forty-four photographs of Asiatic, Turkey, Muscat, Aden, and Suez, taken by B. T. Watts, Esq., 1909–10. *Presented by B. T. Watts, Esq.*

Mr. Watts was for some time engaged on surveying and levelling in the country between the lower Euphrates and Tigris, in connection with the irrigation schemes of Sir Wm. Wilcocks, and it was during these operations that many of these photographs were taken. As may be judged by the titles, some are of special historical interest, and they are all typical of the region.

(1) Ezra's tomb, Tigris river; (2) Kale sale; (3) Arab coffee house, Amara; (4) Bridge of boats at Amara; (5) Narrow neck of land at Ctesiphon bend of the Tigris; (6) Baghdad; (7) Bridge of boats, Baghdad; (8) El Gaim tower and head of the Nahrawan canal; (9) Bed of the old Nahrawan canal near the Rasasi head; (10–12) Narba bridge, Dujail canal; (13) Small coffee and tea stall on Persian pilgrim route to Baghdad at Khan Beni Said; (14) Persian pilgrim carriages, Khan Beni Said; (15) Persian pilgrims, Khan Beni Said; (16) Old "cherrid" at Samarra; (17 and 18) Sammar Arabs; (19) "Gamus" or water buffalos, Tigris river; (20) Snow during survey operations, winter 1909–1910; (21) Survey caravan; (22) "Krot" during high flood of the Tigris; (23) "Safina" on the Tigris; (24) "Cherrid" on the Tigris; (25) Arab encampment on the Tigris; (26) Ruins of Niffur, showing mounds thrown up by American excavators; (27) Ruins of Nillujch; (28 and 29) Nejuri ruins; (30 and 31) Arabs excavating at site of new Hindie barrage; (32) Gate of Istar, Babylon; (33) Arabanas running between Baghdad and Kerbela; (34) Old water-wheel on the Euphrates; (35) Turkish soldiers (Arabs); (36) Aleppo-Badgdad route, showing carriages; (37) Jaffa; (38) Haifa; (39) Indian Marine boat in Persian gulf; (40) Muscat; (41) Rock at Muscat on which are written the names of boats calling at the port; (42) Aden; (43 and 44) Entrance to Suez canal from Suez.

N.B. It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.



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LANESIA

rate the paper by
. H. R. RIVERS.

000,000 or 1 Inch = 157·83 Stat. Miles.
100 200 300

Heights in feet.

been drawn from Admiralty Charts
and 780, with additions and names
supplied by the Author.

EDDYSTONE ISLAND.
(Mandegusu)

Nat. Scale 1: 100,000 or 1 Inch = 1·578 Stat. Miles.

Soundings in fathoms.
Heights in feet.
+ Obsr.y Spot Lat. 8° 16′ 1″ S.
Long. 156° 29′ 33″ E.

Obsr.y Spot
Rock
Cliffs
Rocks 30 ft. High
Simbo I.
Rock

Tsumako
NTA CRUZ
ISLANDS
Uupua I.
Teria I.
Cherry I. (Anuta)
Mitre I. (Fataka)
Tikopia
Rotumah
(Vava)
Vatganai I.
Ureparapara I.
Saddle I. (Motlav)
Merig I.
Merlav
BANKS ISLANDS
Aurora (Maewo)
Pentecost I. (Raga)
Ambrym I.
Lopevi I.
Api or Epi
Tongoa I.
Makura I.
Matase I.
Sandwich I. (Efate)
Dillon B.
Eromanga I.
Aniwa I.
Tanna I.
Futuna I.
Anaitcum I.
LOYALTY ISLANDS
Halgan I. (Uea)
Chabrol I. (Iiji)
Britannia I. (Mare I.)
Cape Charlotte
Walpole I.
I. of Pines
Matthew I.
Hunter I.

FIJI ISLANDS
Thikombia I.
Vanua Levu
Round Island Passage
Yasawa Group
Viti Levu
Koro I.
KORO SEA
Ngau I.
Vatu Leile I.
Kandavu Passage
Moala I.
Kandavu I.

Three Sisters Is.

Soundings in fathoms.
Heights in feet.

Atiki I.
Maru B.
Arosi
Bio
Heuru
Mango
Pagani
Ugi I.
Maraus Lalo
Maraus Paina
Mata
Raturuhi
Te Manibuki
Ferauro
Kahua
Makira
Maraus Tewa
SAN CRISTOVAL
Hauamaroha
Ste Anna I. (Oa Raha)
Ste Catalina (Oa Riki)

Nat. Scale 1: 2,500,000 or 1 Inch = 39·46 Stat. Mls.